

TR-141

TECHNICAL REPORT

OCEANOGRAPHIC STATIONS TAKEN
IN THE INDIAN OCEAN
BY USCGC EASTWIND (WAGB-279) IN 1961

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ABSTRACT

During late March and April 1961, the USCGC EASTWIND (WAGB-279) occupied 30 oceanographic stations in the Indian Ocean. Three sections were made, one running from off Cape Leeuwin, Australia west as far as 78° E. longitude, a second continuing north from this point to 4° N. latitude, and the third which continued west to just south of Socotra Island.

Measurements were made of temperature, salinity, and dissolved oxygen; and from these data density, sound velocity, and percentage of saturation of dissolved oxygen were derived. Transparency was determined by Secchi disc, and the Deep Scattering Layer was observed. Continuous recording of bottom depths by echo sounder was carried out through a region where few soundings had hitherto been reported.

Northward reaching tongues of Antarctic Intermediate water are shown on the southern profile and on the south-north profile along the 78° E. meridian. In mid-Indian Ocean, these masses push up toward the surface causing a divergence which is apparent in the salinity and dissolved oxygen profiles. Also delineated are high salinity waters with very low oxygen content from the Arabian Sea, the Persian Gulf, and the Red Seas. The pattern in the Indian Ocean and re-

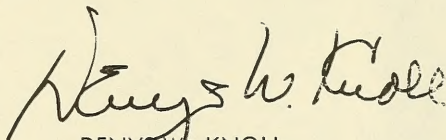
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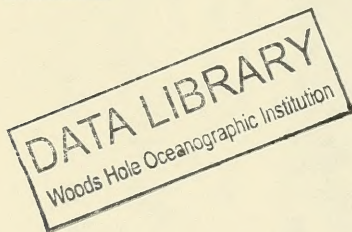
This technical report presents data collected in an area that offers a real challenge to the oceanographer - The Indian Ocean.

The observations from aboard USCGC EASTWIND were made in water where few oceanographic measurements previously had been taken.

These data corroborate the findings of some earlier voyages and add to the marine scientists' knowledge of the environmental conditions of this vast ocean.



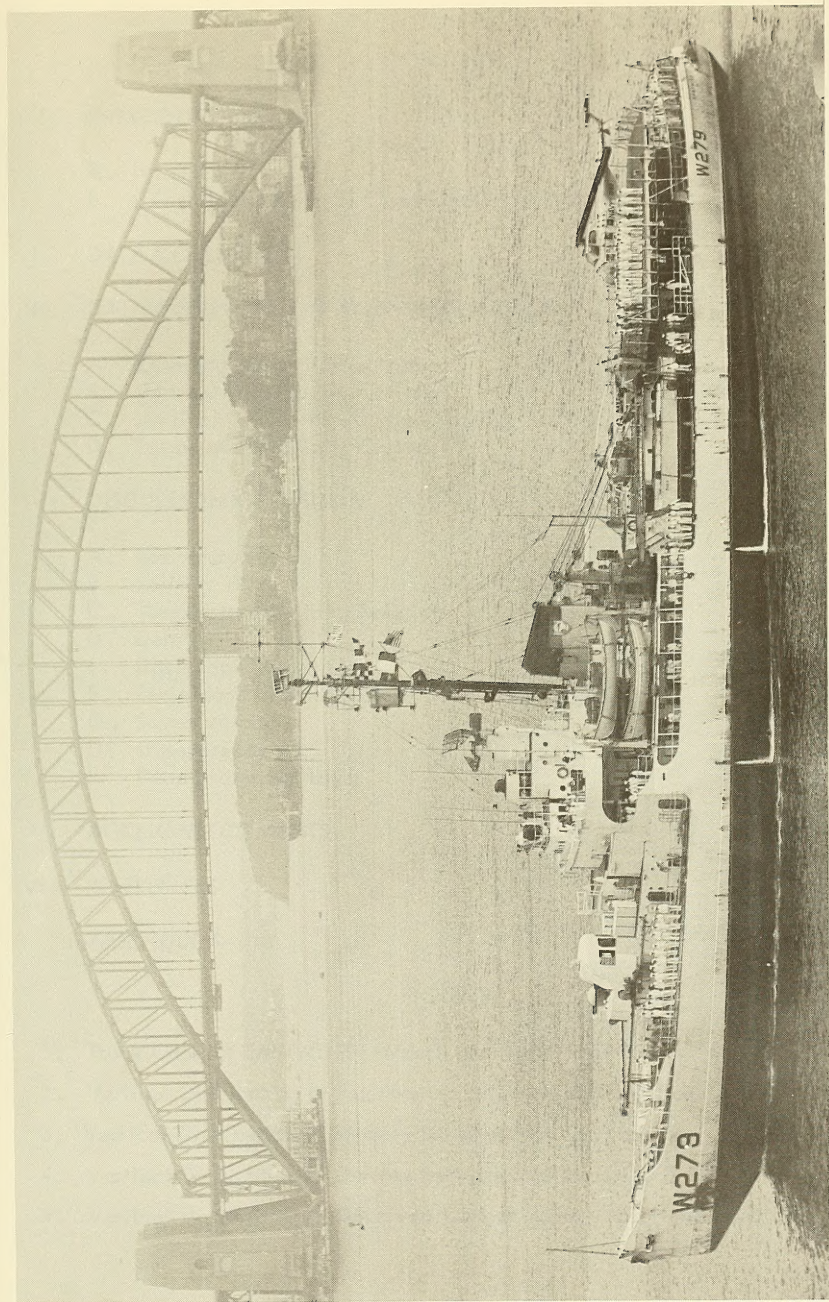
DENYS W. KNOLL
Rear Admiral, U. S. Navy
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USCGC EASTWIND, SYDNEY, AUSTRALIA

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OCEANOGRAPHIC STATIONS TAKEN IN THE INDIAN OCEAN BY USCGC EASTWIND (WAGB-279) IN 1961

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I. INTRODUCTION

A. Historical

On her return trip from the Antarctic in late March and early April 1961, the U. S. Coast Guard icebreaker EASTWIND, Captain J. W. Naab, USCG, Commanding, took 30 oceanographic stations in the south-eastern, central, and northwestern sections of the Indian Ocean (Fig. 1). This was part of the International Indian Ocean Expedition, the EASTWIND being among the first ships to participate in this great undertaking. Three sections were made: The first, east to west from off Cape Leeuwin, Australia along the 32° S. parallel of latitude from 110° to 78° east longitude; the second, north from 32° S. latitude along the 78° E. meridian as far north as 4° N. latitude; and the third, north and west from 8° N. 70° E. to 12° N. 54° E. The east-west section comprised 5 stations, the south-north section 23 stations, and the north-west section 4 stations.

Although the Indian Ocean is, perhaps, the least known oceanographically of all the major bodies of water, a fairly large number of vessels, nevertheless, have taken oceanographic stations there. Most of these observations, however, until recently, had been taken in the western and northern portions, and comparatively little had been reported on the great central water mass. Commencing with voyages of the GAZELLE and CHALLENGER in the 1870's and winding up with those of the DIAMANTINA from 1959 to 1962, the list of ships which have occupied oceanographic stations in the Indian Ocean is impressive. It includes such well known names as DANA, DISCOVERY II, METEOR, PLANET, WILLEBRORD SNELLIUS, NORSEL, VALDIVIA, ORMONDE, GAUSS, VITYAZ, MÖWE, CDT. CHARCOT, MABAHISS, ALBATROSS, and others.

In 1935, DISCOVERY II, returning from the Antarctic, ran a section through the Mozambique Channel, and this series of stations has been the basis for much of the present knowledge of the oceanography of the western portion of the Indian Ocean. Another important section was taken by DANA from Sumatra west across the northern portion of the Indian Ocean as far as Cape Delgado, Africa. North and south sections were made along the

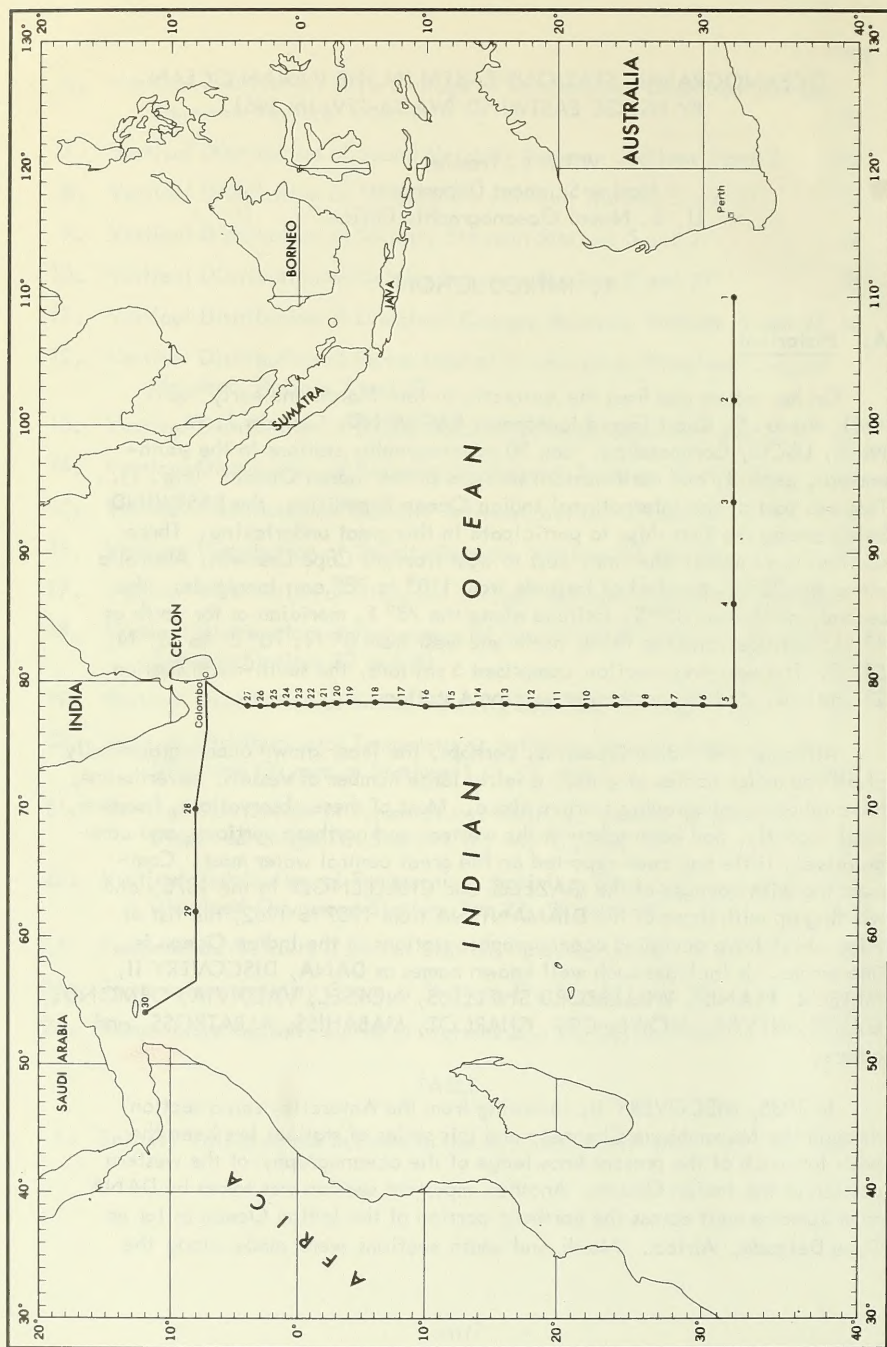


FIGURE 1. TRACK CHART OF EASTWIND, MARCH AND APRIL 1961

75° E. meridian by NORSEL in 1956, on the 90° E. meridian by DISCOVERY II in 1951, near the 86° E. meridian by ALBATROSS in 1945, and at 56° E. longitude on a line running from west of Madagascar to Cape Guardafui by NORSEL in 1955. In 1933, MABAHISS ran a section from the equator at about 63° E. longitude to the Gulf of Oman. Between the years 1959 and 1962, H.M.A.S. DIAMANTINA, operated by the Australian Commonwealth Scientific and Industrial Organization, Division of Fisheries and Oceanography (C.S.I.R.O., 1962, and 1962a), participated in a series of cruises that covered most of the waters to the south, west, and northwest of Australia. Three of her tracks ran along the 32° S. parallel, one of which continued to 95° E. longitude. In 1960, the Lamont Geological Observatory research vessel VEMA ran a track which zig-zagged across the 32° S. parallel and which extended as far west as Mauritius Island. In 1959 and 1960, the U.S.S.R. research vessel VITYAZ covered a large portion of the Indian Ocean with her cruises, of which one leg was slightly north of the 32° S. parallel. Other VITYAZ cruises paralleled the south-north profile of EASTWIND on both eastern and western sides along the 72°, 83°, and 90° meridians. A preliminary account of the results of these cruises is reported upon in Okeanologiya (Bezrukov, 1961). The Scripps Institution of Oceanography's research vessel ARGO, in 1960, ran cruise tracks south and north of the 32° S. parallel as far west as Mauritius. By far the most comprehensive of the recent works on the Indian Ocean is that of Muromtsev on "The Basic Pattern of the Hydrology of the Indian Ocean" (Muromtsev, 1959). An extensive data compilation from all available sources, as well as vertical sections, and areal distribution charts of temperature, salinity, density, and dissolved oxygen, accompnys Muromtsev's report. The International Indian-Ocean Expedition plans call for an extensive and practically complete coverage of all parts of the Indian Ocean between the years 1963 and 1965 or 1966.

B. General Discussion of Oceanography of Indian Ocean

The Indian Ocean has long been believed to be similar to the Atlantic, and indeed there are several striking resemblances. Both bodies of water have midridges which join south of the Cape of Good Hope. Both ridges have a rift valley and are centers of seismic activity. The continuity of the two ridges and their rift valleys was recently confirmed from crossings made by VEMA in 1959 and 1960 (Ewing and Heezen, 1960). The Mediterranean feeds water of high salinity into the Atlantic, and the Arabian and Red Seas feed high salinity water into the Indian Ocean. The more important source of high salinity intermediate water for the Indian Ocean is the Arabian Sea; the Persian Gulf is too shallow to furnish much water southward. However, in the Red Sea, a salinity as high as 40‰ is caused by intensive evaporation and almost complete lack of run off from the land. This water at intermediate depths may be traced in the western portion of the Indian Ocean as far south

as the 40° parallel. The Red Sea, nevertheless, is much less important in supplying the Indian Ocean with water than is the Mediterranean the Atlantic because the Red Sea supply is variable with the season and from year to year.

However, unlike the Atlantic, in the Indian Ocean there is apparently no deep, northward-flowing return current, or if such exists, it is of much less importance and is sluggish. Also, the intermediate water is characterized by its low oxygen content which is lowest in the north and which increases toward the south, apparently gaining oxygen by mixture with other water (Sverdrup, Johnson, and Fleming, 1942).

Much of the earlier data collected in the Indian Ocean were either inaccurate or insufficiently refined for use in determining water mass movements. Thus, Möller's sections based on work prior to 1929 (Möller, 1929) are not generally recognized today. The work of Clowes and Deacon (1935) and Deacon (1937) were perhaps the earliest attempts at an accurate picture of circulation in the Indian Ocean. Later, the published reports of Tchernia, Lacombe, and LeFloch (1951) and of Tchernia, Lacombe, and Guibout (1958) have made use of more recent data. Circulation of the deep water in the western Indian Ocean was reported upon in a recent paper by Le Pichon (1960) in which the "core method" together with geostrophic computations were used. Le Pichon reported a deep current setting to the north which was deflected and weakened by the complex system of ridges. Deacon's (1937) idea of the mixing of Atlantic deep water with Indian Ocean water south of Africa was also confirmed in Le Pichon's paper.

Surface and near-surface currents form a rather complex pattern which varies with the season and from year to year. In general, an easterly current sets between Africa and Australia, and during the summer this bends and joins a current coming from the Pacific south of Australia. In winter this current continues on along the southern Australian Coast. The southern part of the Indian Ocean has a large anticyclonic system of currents which, again, is similar to that found in the Atlantic, but the currents in the Indian Ocean are much more variable. North of 20° S., a westerly setting, equatorial current flows. This current is strongest in winter because it is reinforced with water from the Pacific coming along north of Australia; however, in summer, the water north of Australia flows into the Pacific. The Agulhas Current, which sets south along the African coast, is reinforced by part of the South Equatorial Current which turns south. Most of this strong current returns to the Indian Ocean south of Africa, but some, apparently, turns westward and flows into the Atlantic. Probably some Antarctic Intermediate water flows northward in the southern portion of the Indian Ocean. Deep water from the Atlantic comes into the Indian Ocean around Africa. There is, evidently, some intermixing of intermediate water with deep water and bottom water. Red Sea water can be traced as far south as the Antarctic (Thomsen, 1933, 1935).

The generalized pattern of circulation and hydrology given above in its broader aspects is definitely lacking in detail, but many existing questions may be answered when results are published from recent cruises and from scheduled International Indian Ocean Expedition cruises.

II. DATA COLLECTION

Standard oceanographic station procedure as practiced by the U. S. Naval Oceanographic Office Oceanographers (H. O. Pub. No. 607, 1955), was carried out at each of the 30 stations occupied. A volunteer team of four Coast Guard enlisted men directed by Chief Quartermaster Davis, USN, collected the samples and assisted in some of the laboratory work. Paired reversing thermometers were attached to Nansen bottles, and bottles were placed at all intermediate standard depths. Dissolved oxygen was determined by the unmodified Winkler method on board ship. Salinity samples were sealed in citrate bottles and returned to the Oceanographic Laboratory of the U. S. Naval Oceanographic Office. Determination of salinity was made with a University of Washington type salinometer. Depths at which observations were actually made were determined by thermometric calculation from readings of protected and unprotected thermometers. Accuracy of observations is considered to be $\pm 0.02^{\circ}$ C. for temperature, ± 0.05 parts per thousand (‰) for salinity, and ± 0.05 milliliters per liter for dissolved oxygen. Percentage of saturation of dissolved oxygen was interpolated from Fox's Tables (Fox, 1907). When light permitted, transparency was determined with a 30 cm. white Secchi disc. Meteorological information was obtained every 3 hours by aerographers assigned to the icebreaker. Continuous underway soundings were made by a UQN-1B echo sounder.

III. DATA COMPUTATION AND PRESENTATION

A. Oceanographic Station Data

These data were processed, coded, and forwarded to the National Oceanographic Data Center for machine interpolation of values at standard depths and computation of density ($\Sigma-t$), anomaly of dynamic depth from the surface to each level, and sound velocity¹.

These oceanographic station data are presented in Appendix A.

B. Vertical Distribution Profiles

Temperature, Salinity, Density ($\Sigma-t$), Dissolved Oxygen, percentage Saturation of Dissolved Oxygen, and Sound Velocity were plotted as vertical distribution profiles for each of the three sections of the cruise. These are presented as figures 2 through 19.

Contours represent the author's interpretation and have been constructed as closely as possible to the observed values. Limitations caused by positioning of stations and determinations of sample depths make the profiles portray a general picture of conditions rather than a precise delineation of oceanographic parameters throughout the section.

C. Vertical Distribution Station Graphs

Vertical distribution graphs were prepared for selected stations along the cruise track. These are presented as figures 20, 21, and 22.

D. Temperature-Salinity Curves

Temperature-Salinity (T-S) curves were constructed for selected stations along the cruise track. These are presented as figures 23, 24, and 25.

¹KUWAHARA, Susumu, Velocity of sound in sea water and calculation of the velocity for use in sonic sounding, Hydr. Rev., v. 16, no. 2, pp.123-140, 1939.

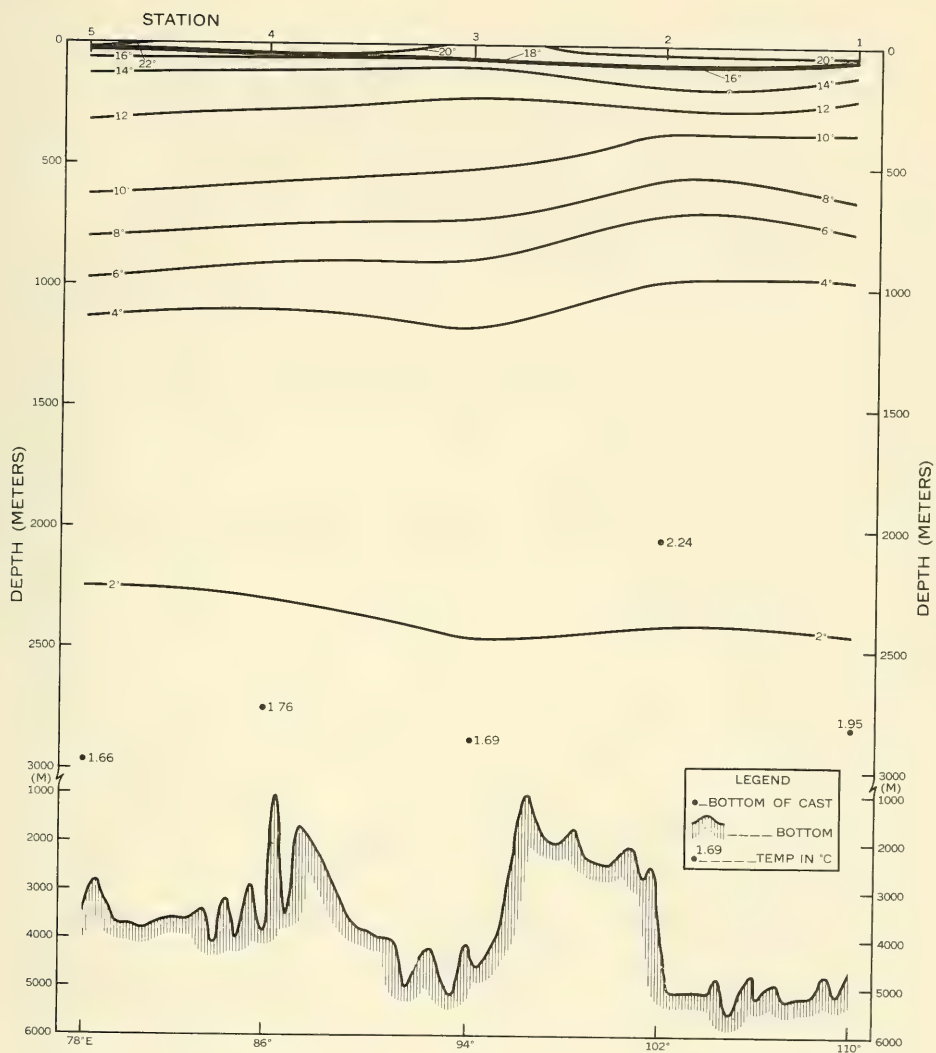


Fig 2

FIGURE 2. VERTICAL DISTRIBUTION OF TEMPERATURE BETWEEN STATIONS 1 and 5.

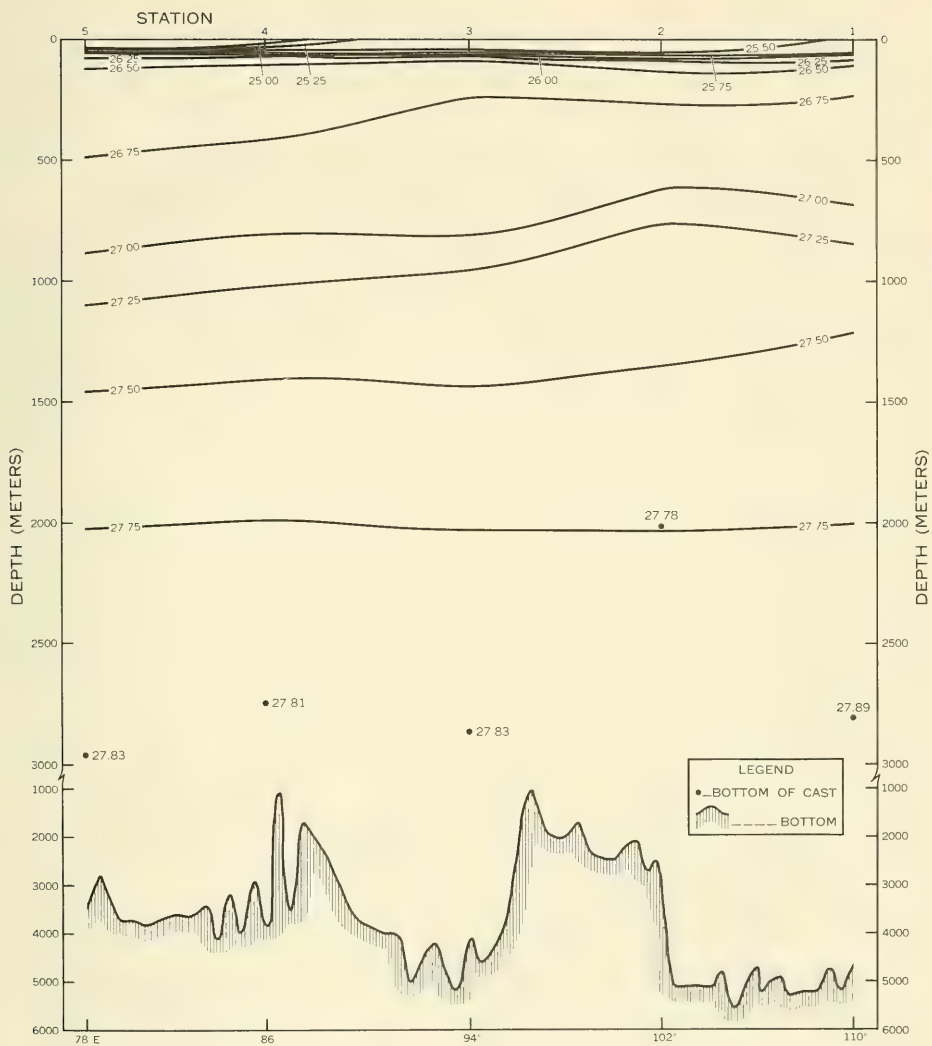


Fig 4

FIGURE 4. VERTICAL DISTRIBUTION OF DENSITY (SIGMA-T) BETWEEN STATIONS 1 and 5.

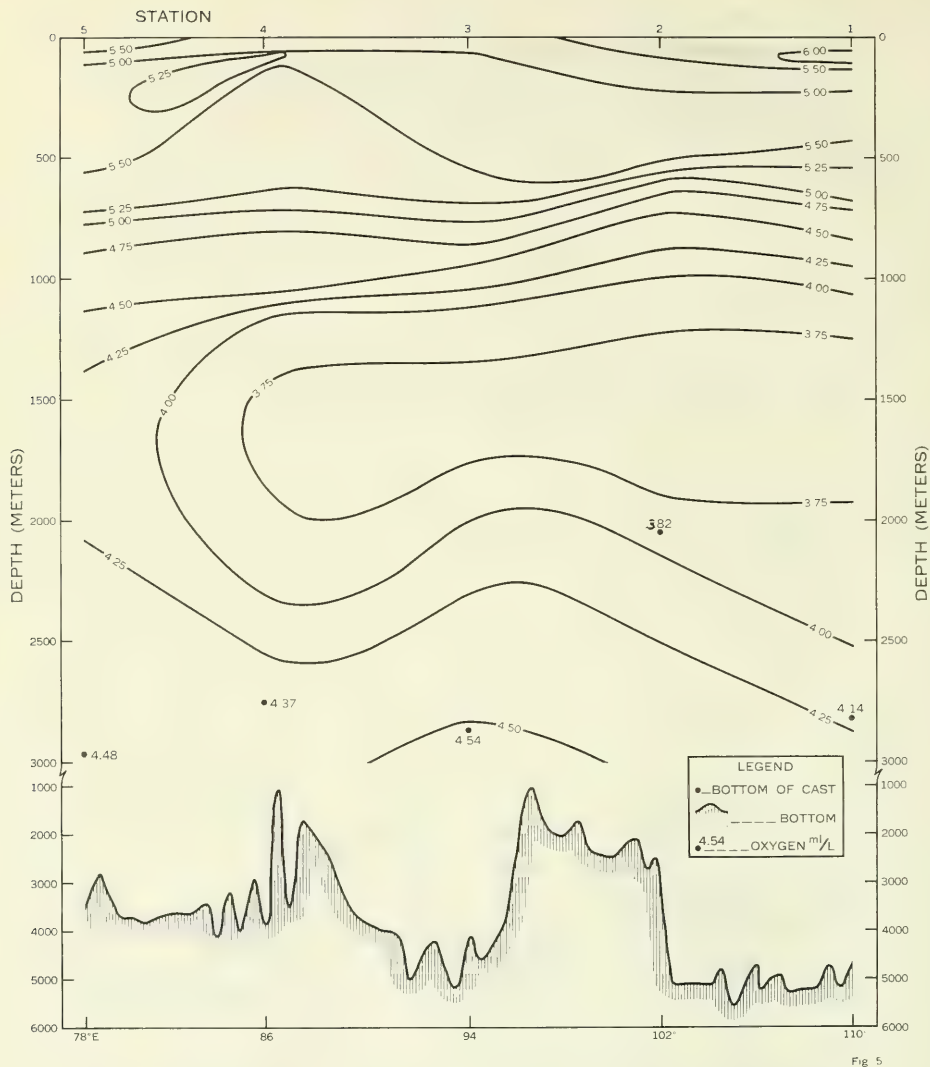


FIGURE 5. VERTICAL DISTRIBUTION OF DISSOLVED OXYGEN BETWEEN STATIONS 1 and 5.

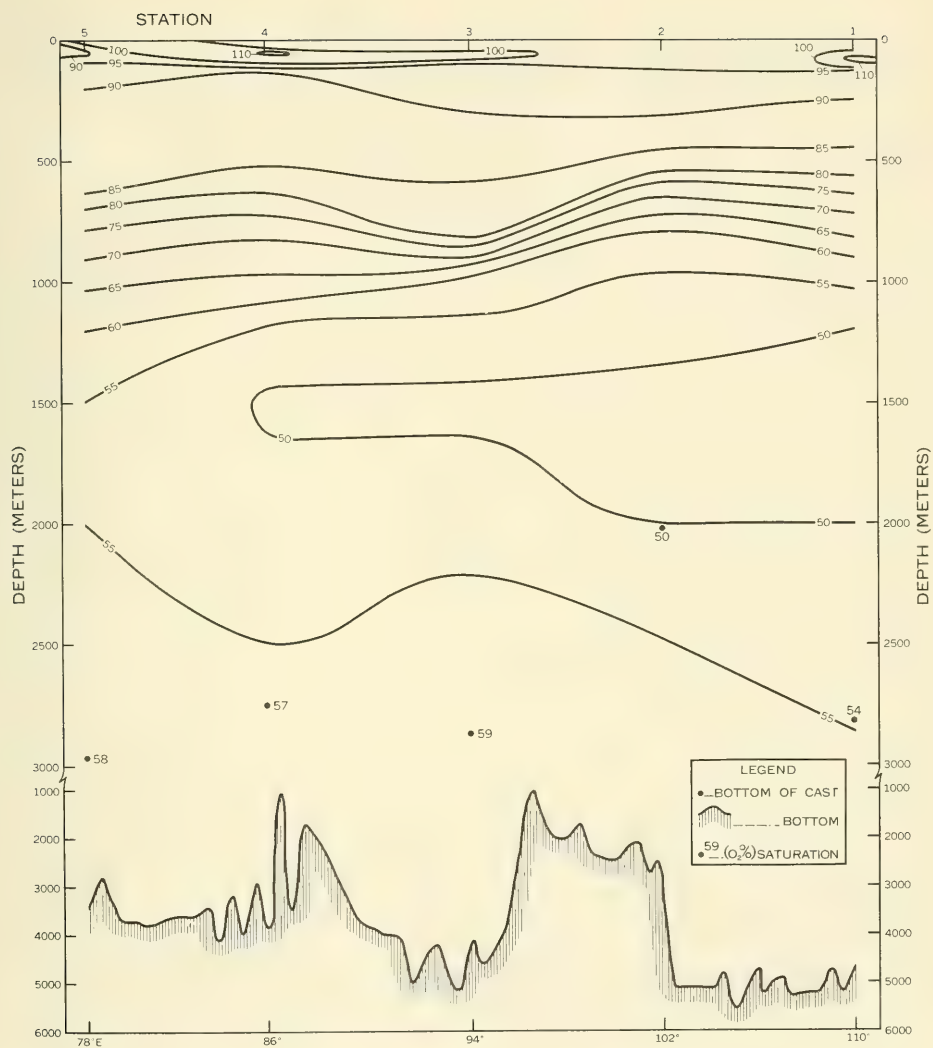


Fig 6

FIGURE 6. VERTICAL DISTRIBUTION OF PERCENTAGE OF SATURATION OF DISSOLVED OXYGEN BETWEEN STATIONS 1 and 5.

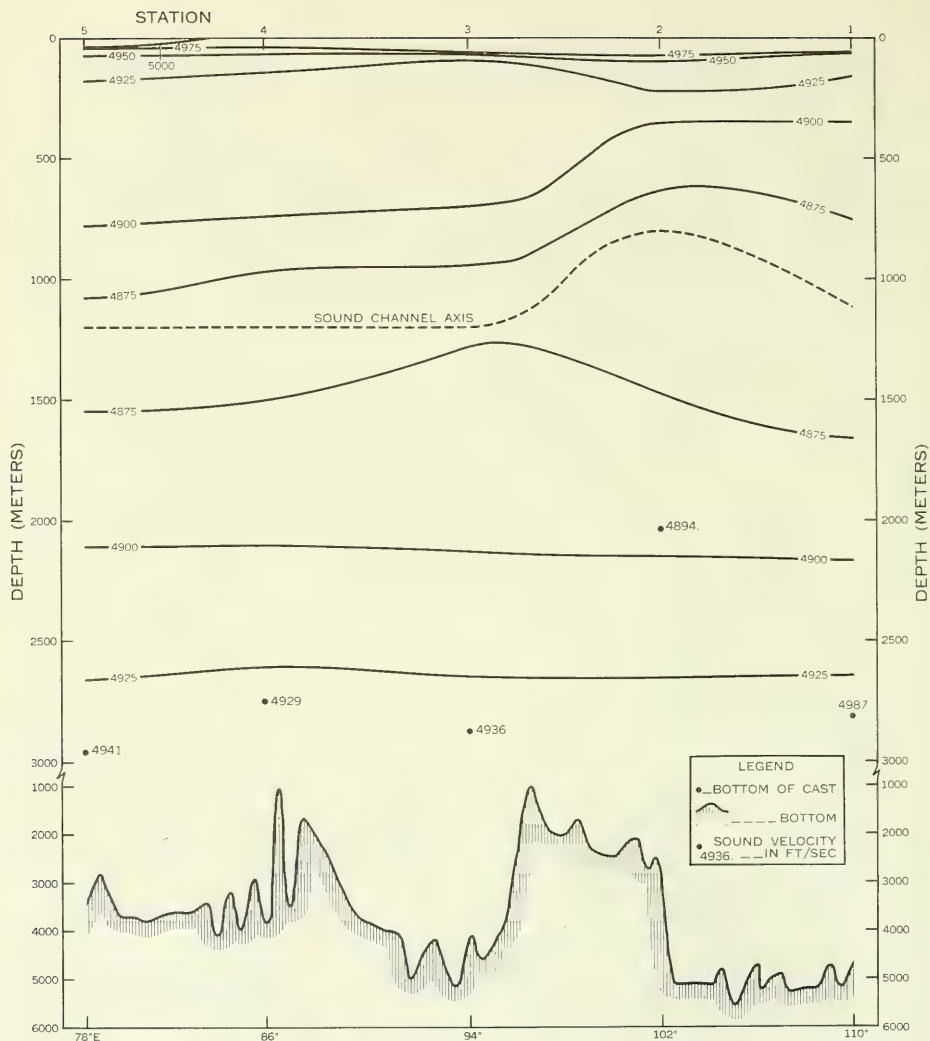


Fig 7

FIGURE 7. VERTICAL DISTRIBUTION OF SOUND VELOCITY BETWEEN STATIONS 1 and 5.

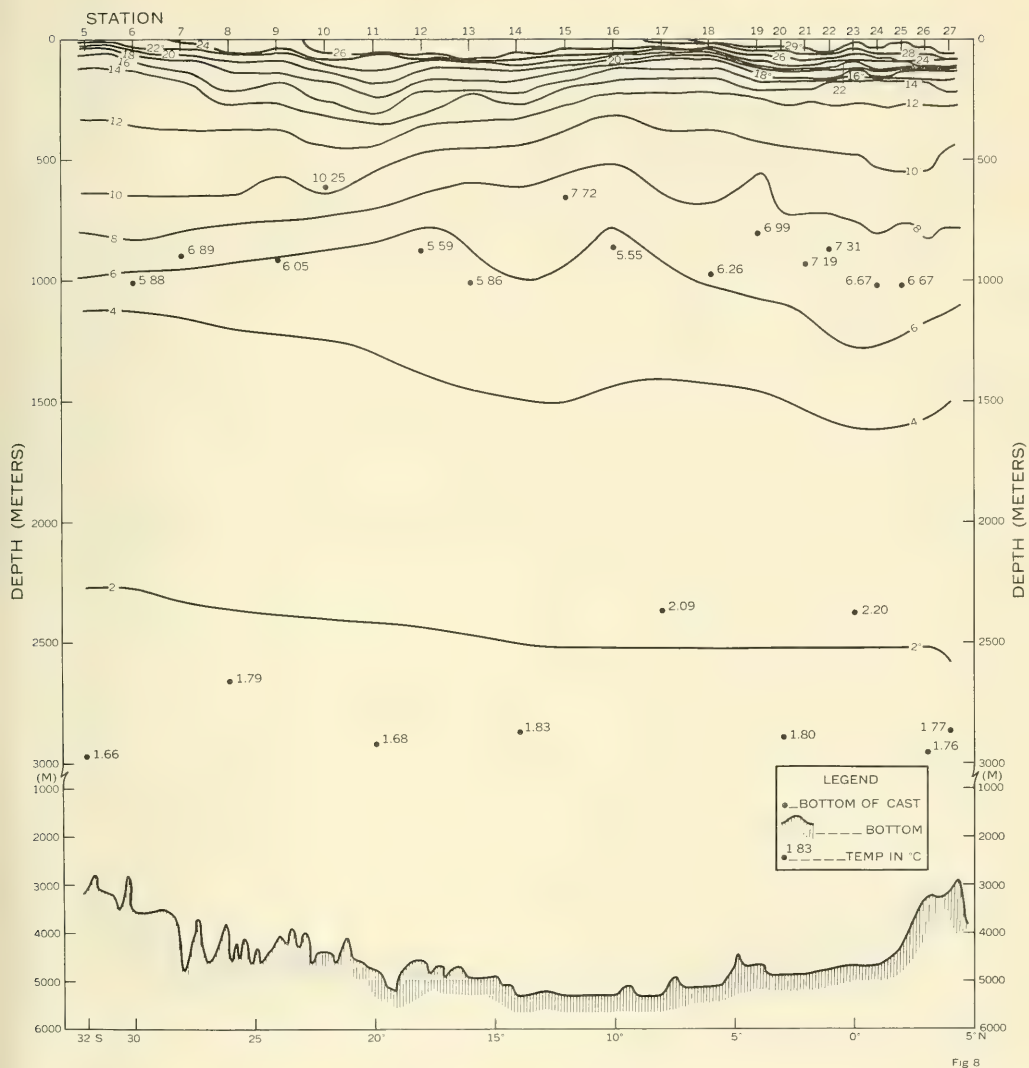


FIGURE 8. VERTICAL DISTRIBUTION OF TEMPERATURE BETWEEN STATIONS 5 and 27.

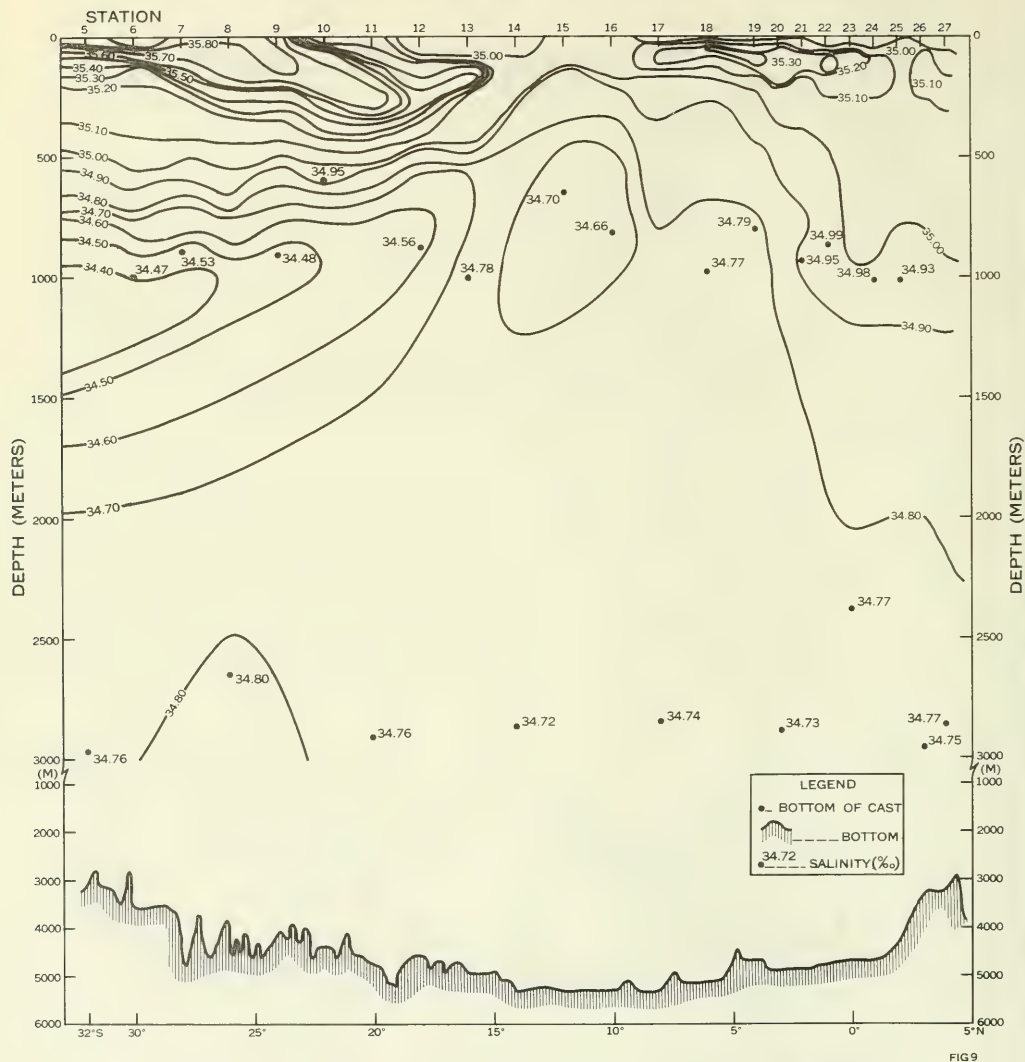


FIGURE 9. VERTICAL DISTRIBUTION OF SALINITY BETWEEN STATIONS 5 and 27.

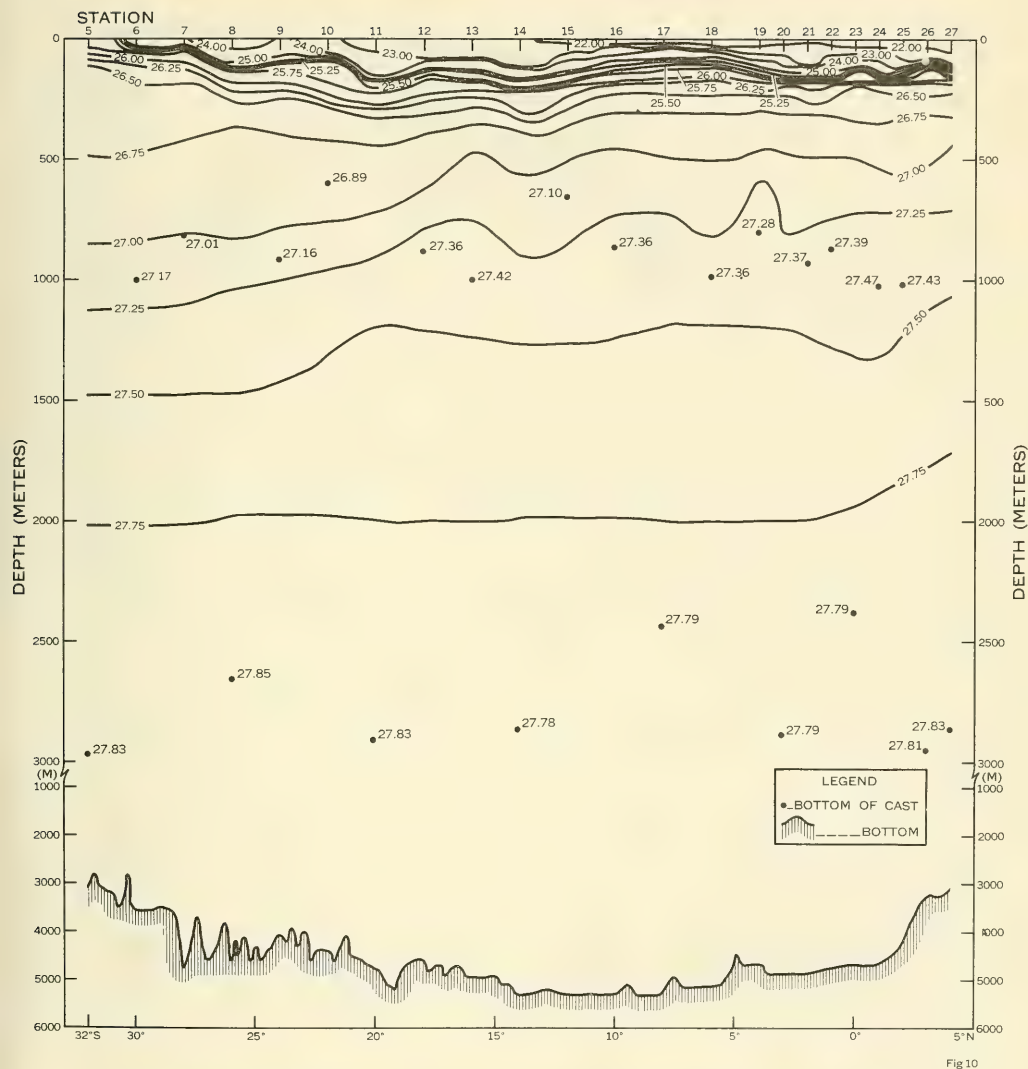


FIGURE 10. VERTICAL DISTRIBUTION OF DENSITY (σ_t) BETWEEN STATIONS 5 and 27

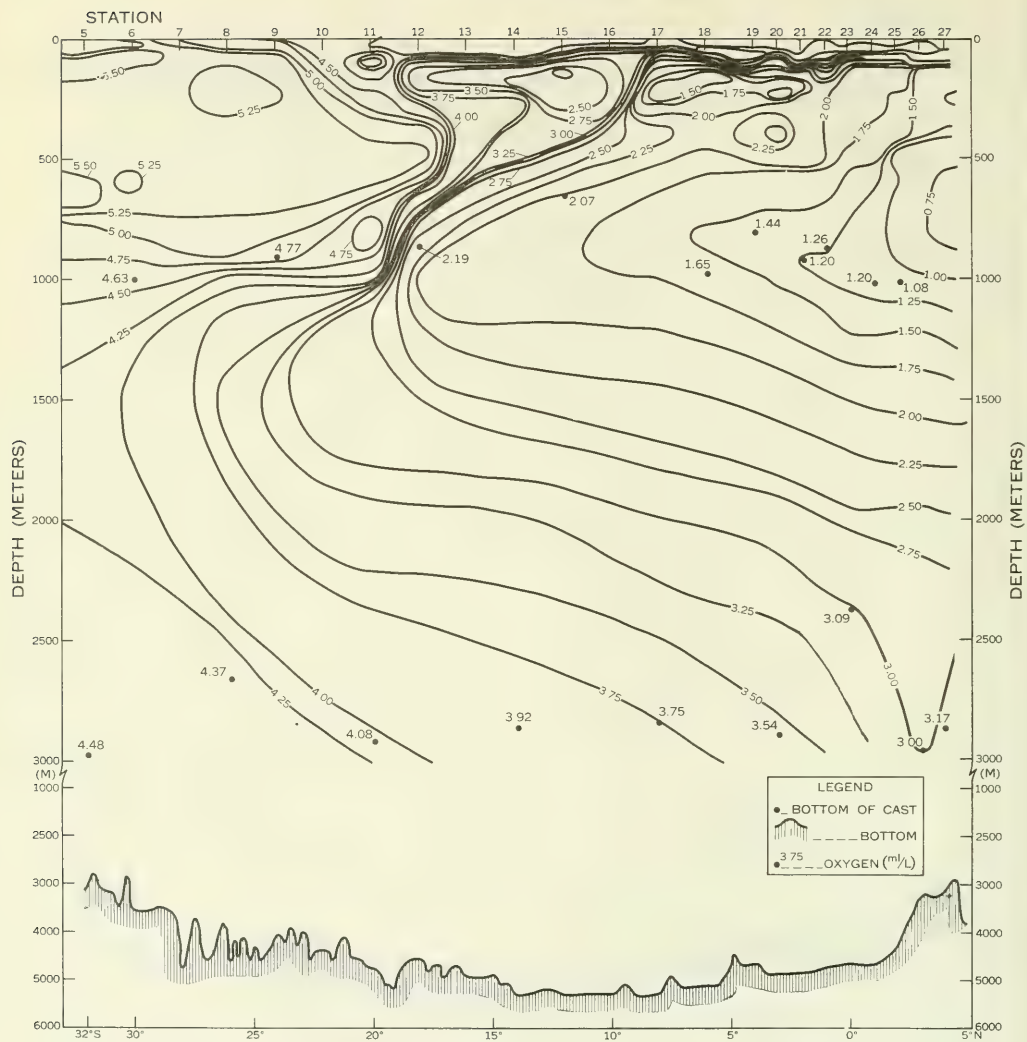


FIG 11

FIGURE 11. VERTICAL DISTRIBUTION OF DISSOLVED OXYGEN BETWEEN STATIONS 5 and 27.

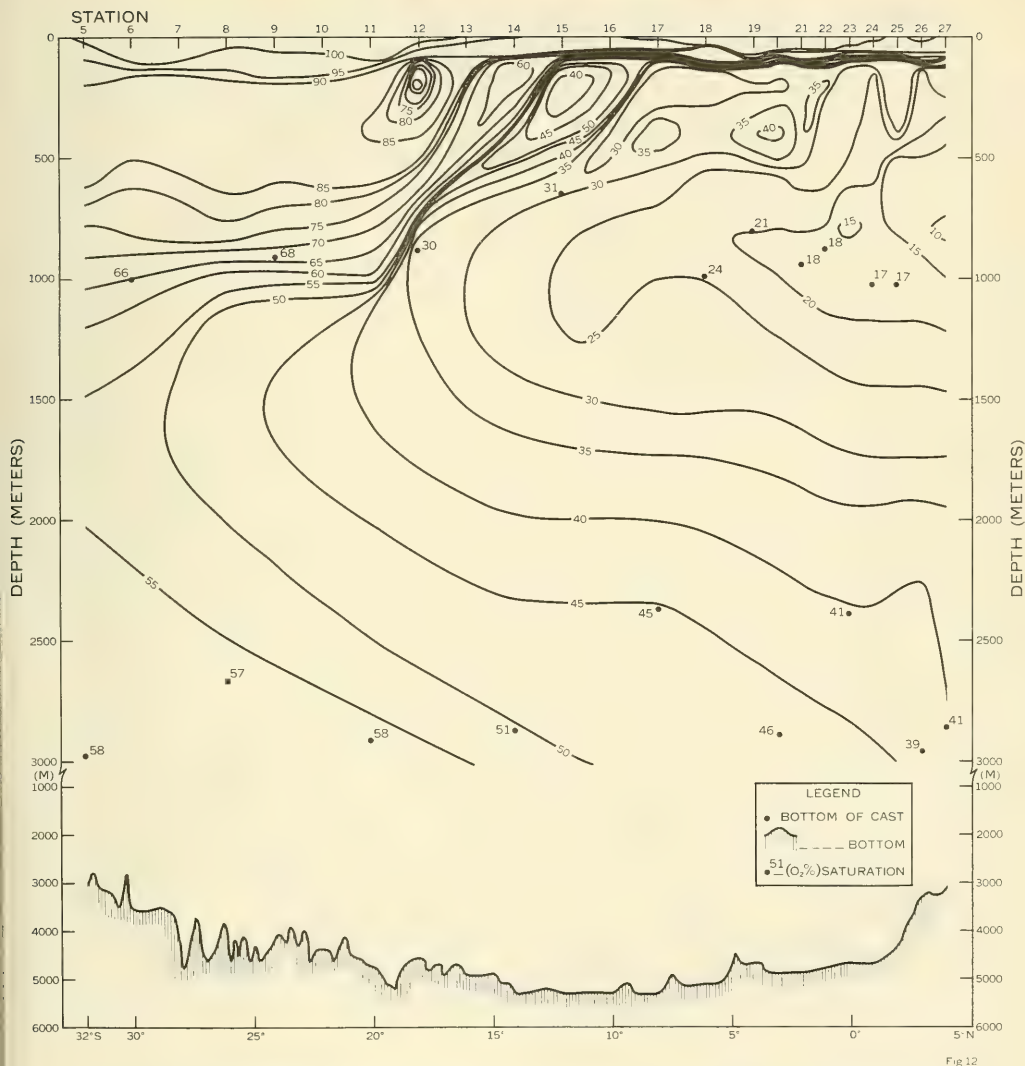


Fig 12

FIGURE 12. VERTICAL DISTRIBUTION OF PERCENTAGE OF SATURATION OF DISSOLVED OXYGEN BETWEEN STATIONS 5 AND 27.

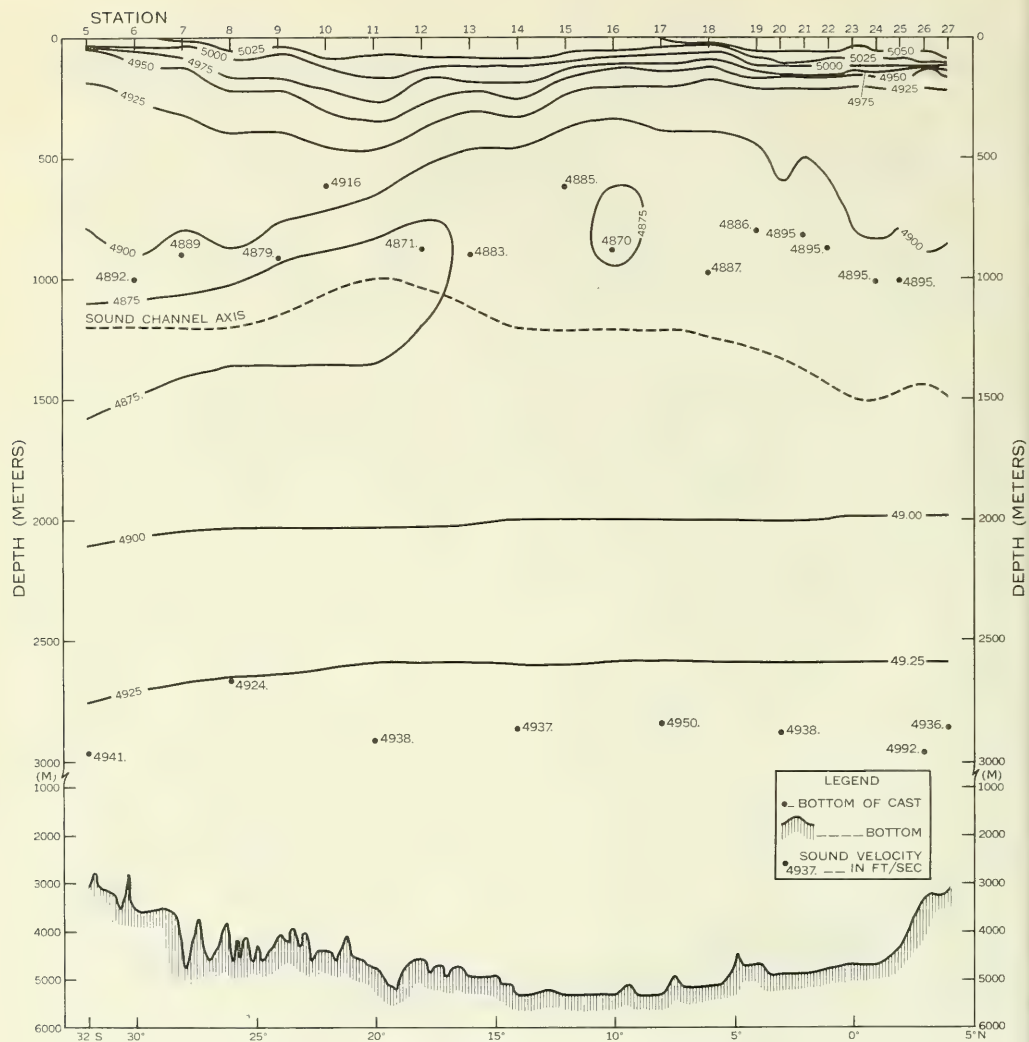


Fig 13

FIGURE 13. VERTICAL DISTRIBUTION OF SOUND VELOCITY BETWEEN STATIONS 5 and 27.

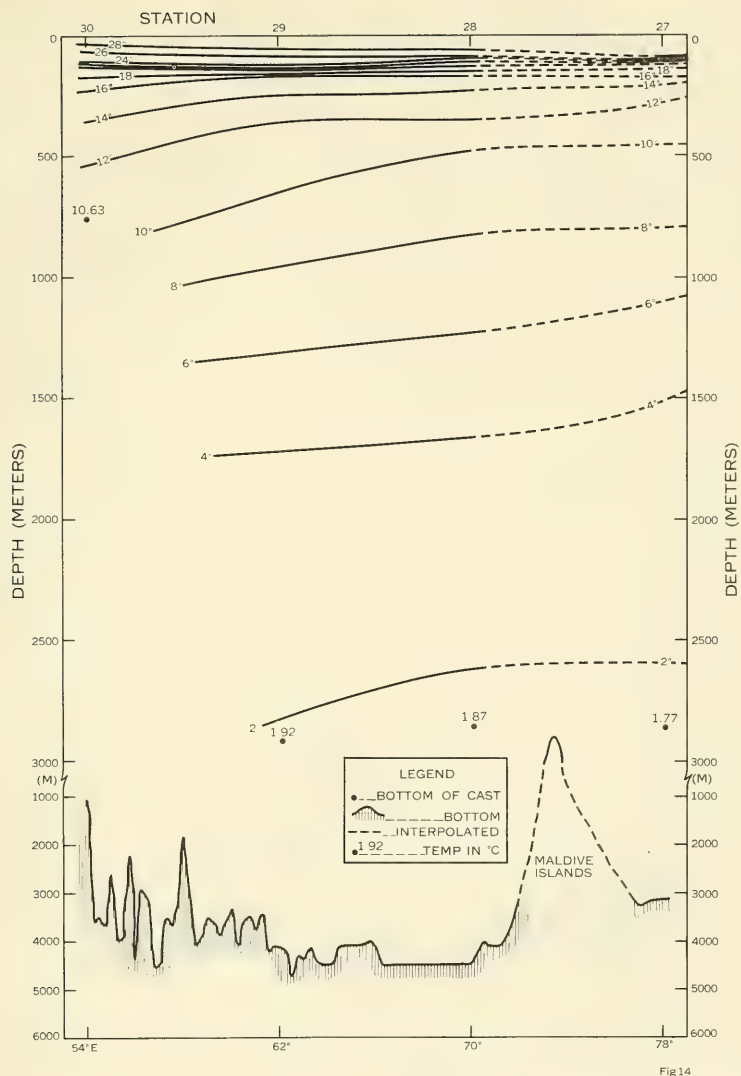


FIGURE 14. VERTICAL DISTRIBUTION OF TEMPERATURE BETWEEN STATIONS 27 and 30.

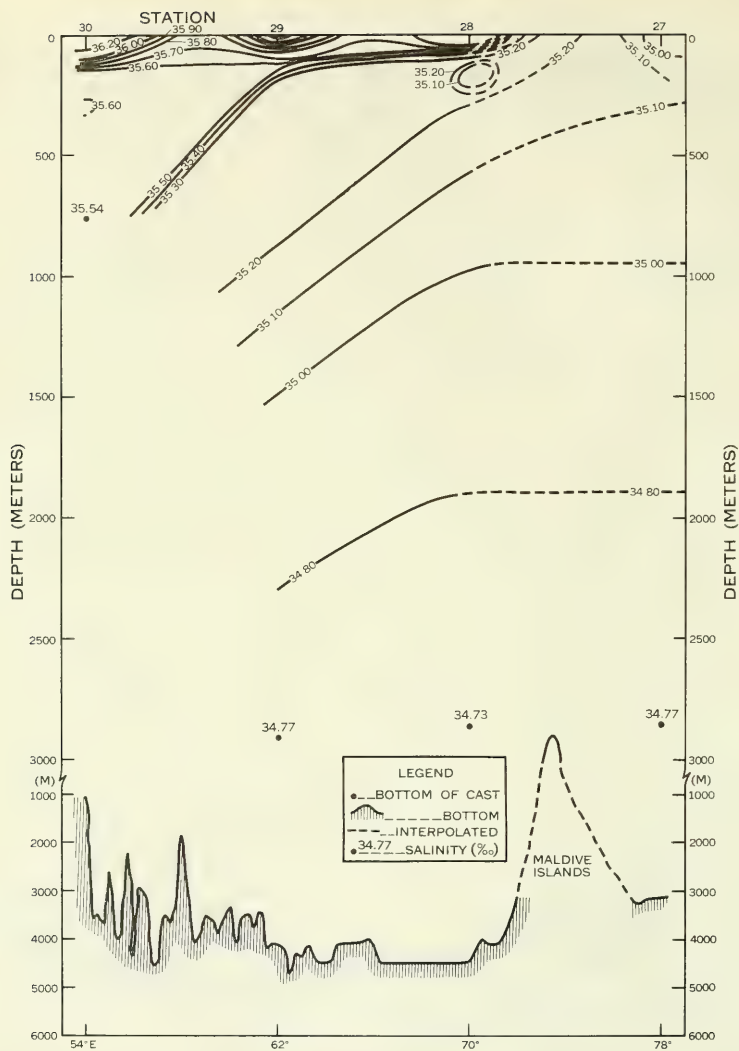


Fig 15

FIGURE 15. VERTICAL DISTRIBUTION OF SALINITY BETWEEN STATIONS 27 and 30.

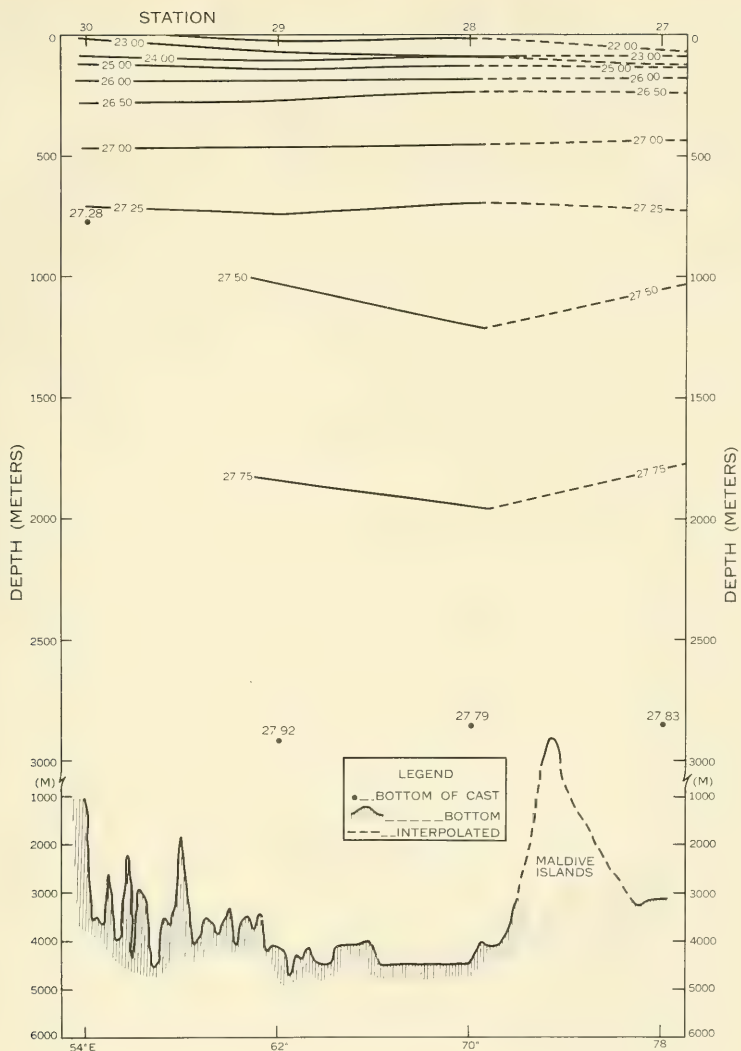


Fig 16

FIGURE 16. VERTICAL DISTRIBUTION OF DENSITY (SIGMA-T) BETWEEN STATIONS 27 and 30.

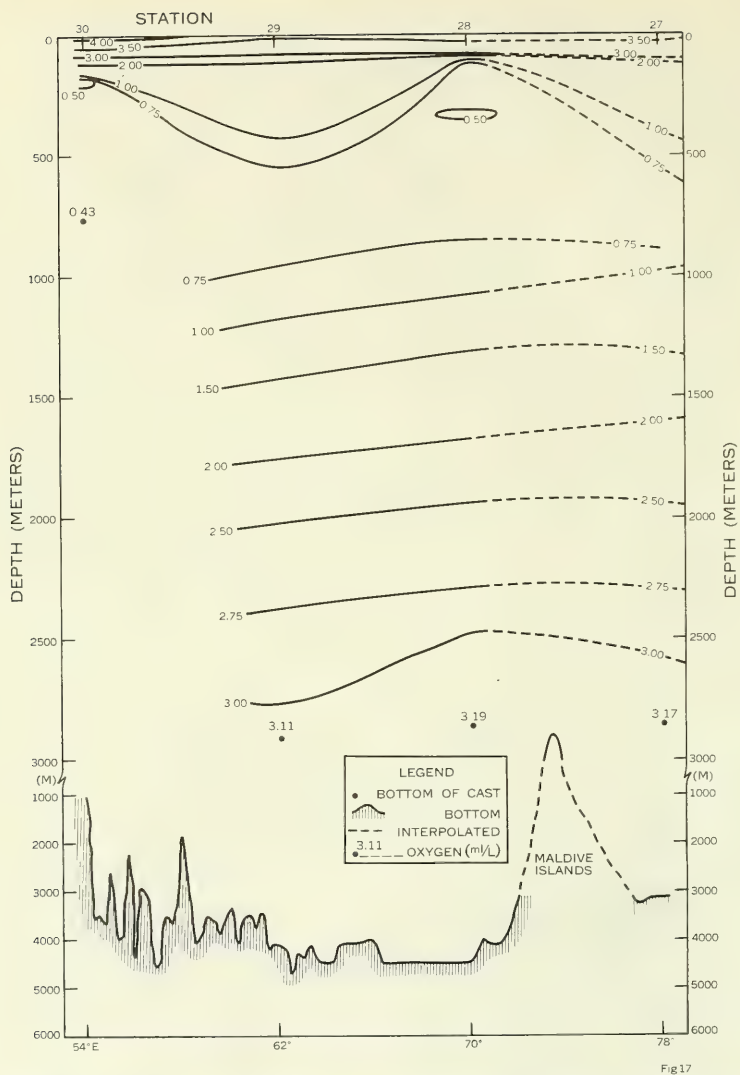


FIGURE 17. VERTICAL DISTRIBUTION OF DISSOLVED OXYGEN BETWEEN STATIONS 27 and 30.

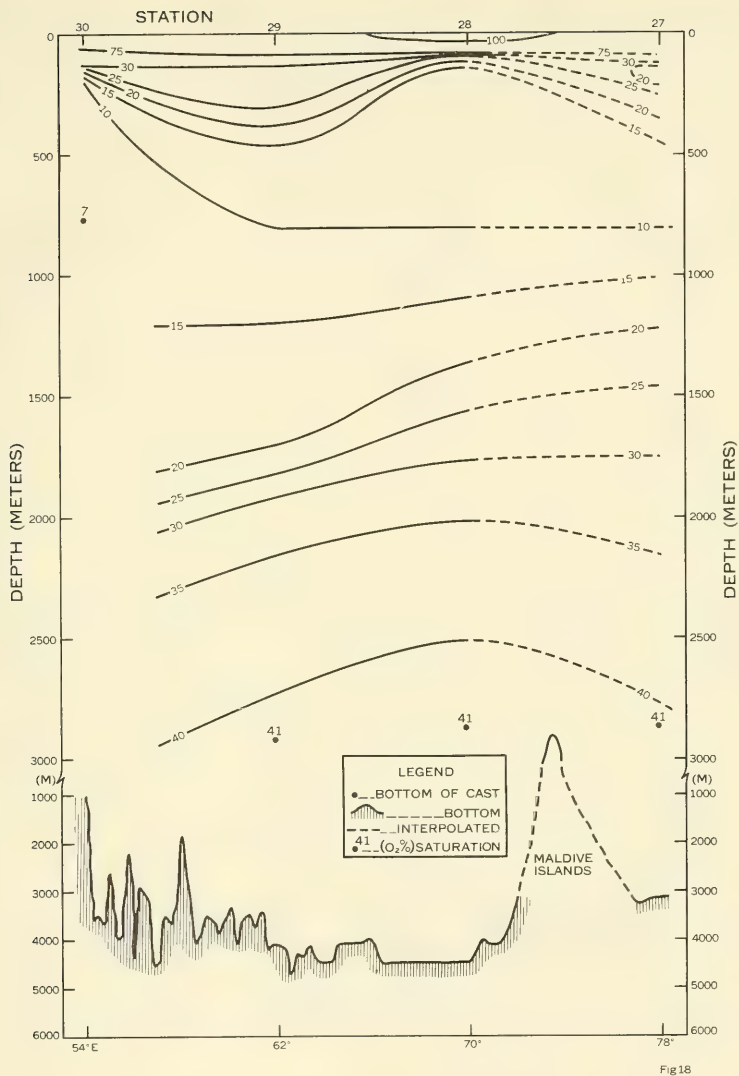


FIGURE 18. VERTICAL DISTRIBUTION OF PERCENTAGE OF DISSOLVED OXYGEN BETWEEN STATIONS 27 and 30.

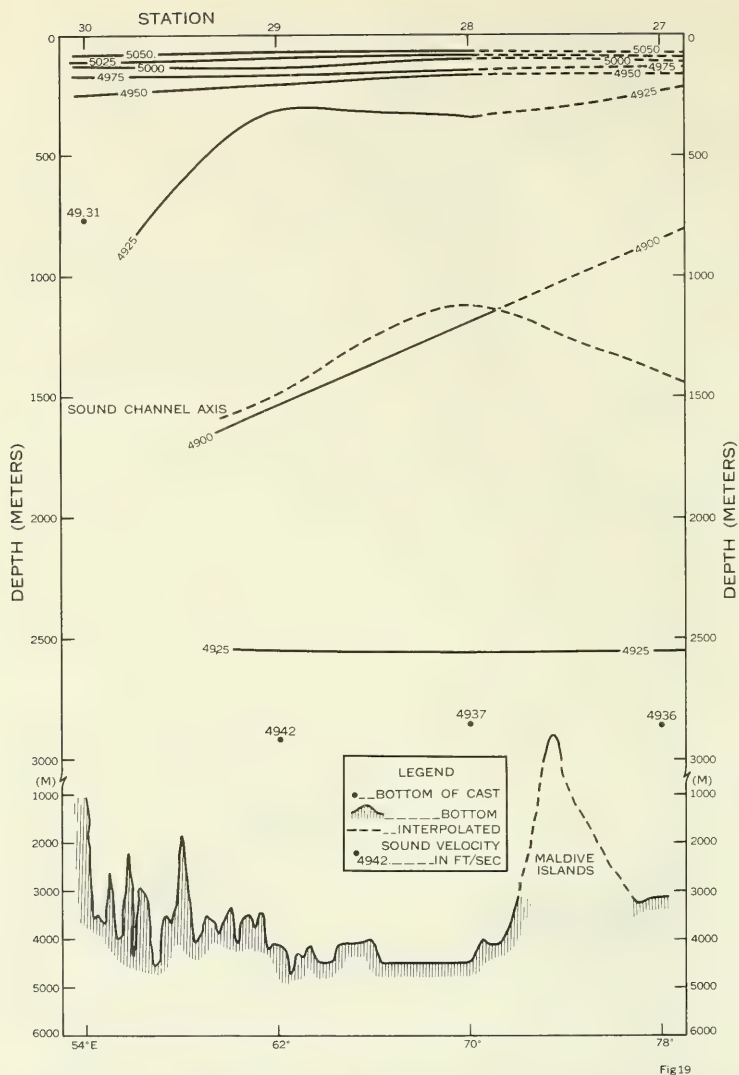


FIGURE 19. VERTICAL DISTRIBUTION OF SOUND VELOCITY BETWEEN STATIONS 27 and 30.

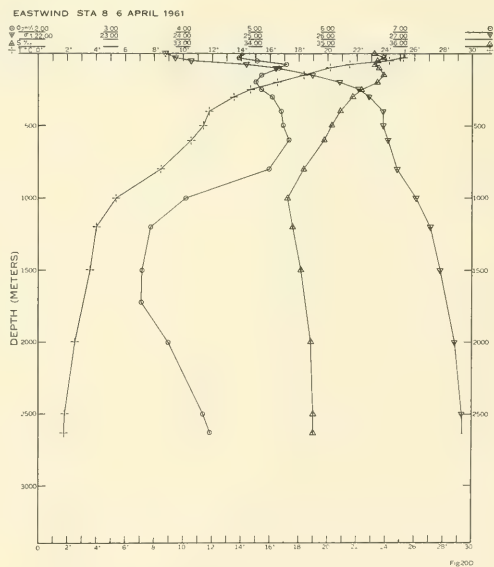
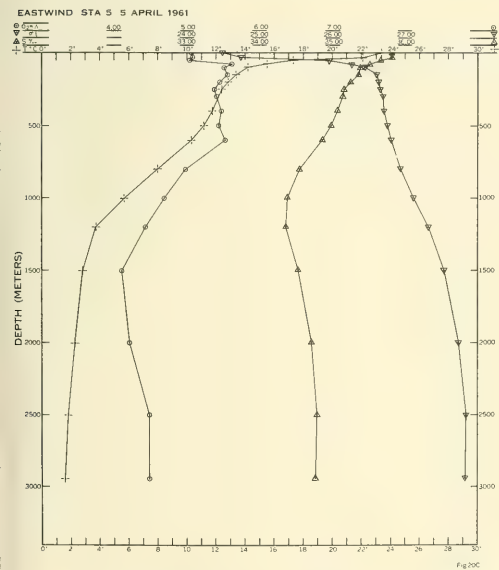
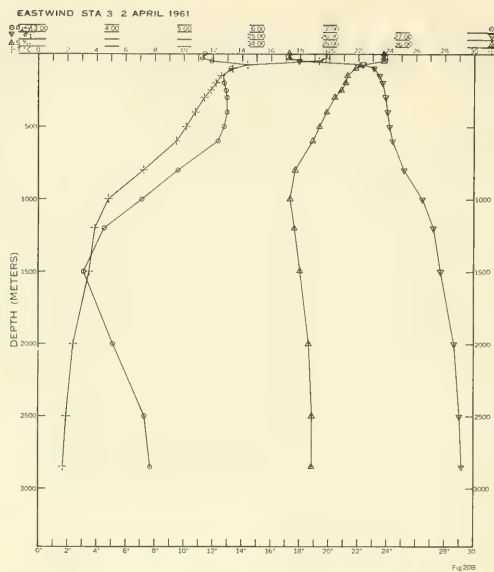
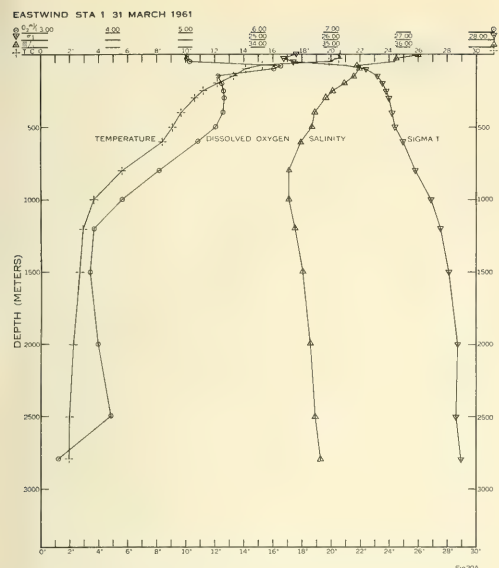
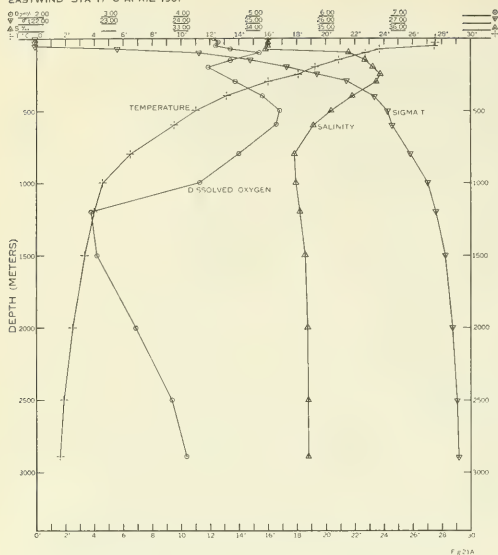
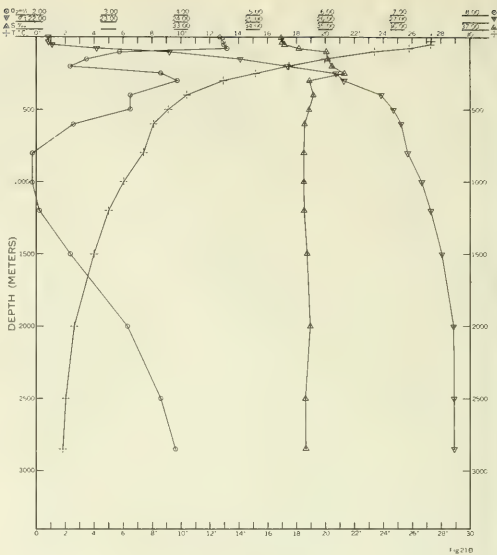


FIGURE 20. VERTICAL DISTRIBUTION OF TEMPERATURE, SALINITY, DENSITY (SIGMA-T), AND DISSOLVED OXYGEN AT STATIONS 1, 3, 5 and 8.

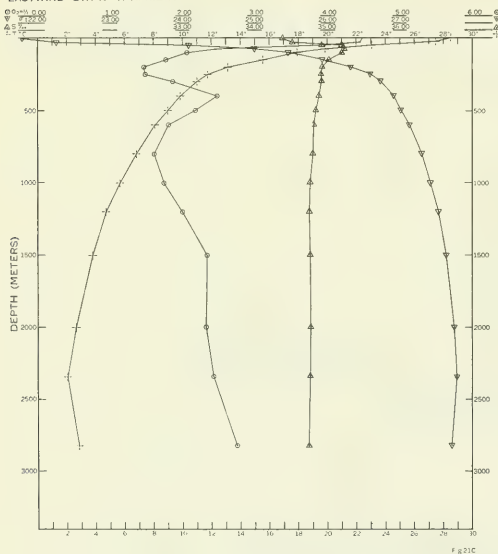
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EASTWIND STA 14 9 APRIL 1961



EASTWIND STA 17 11 APRIL 1961



EASTWIND STA 20 12 APRIL 1961

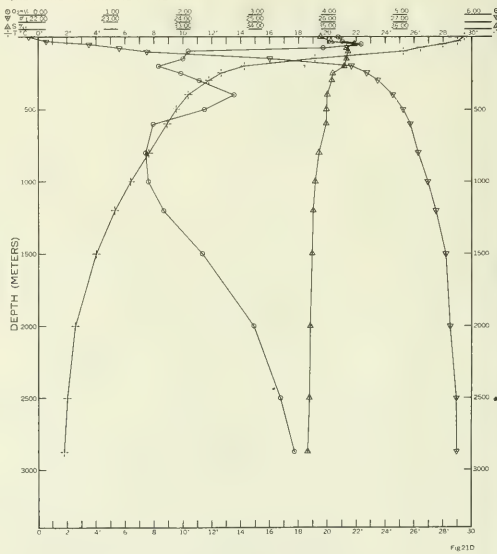


FIGURE 21. VERTICAL DISTRIBUTION OF TEMPERATURE, SALINITY, DENSITY (SIGMA-T), AND DISSOLVED OXYGEN AT STATIONS 11, 14, 17, and 20.

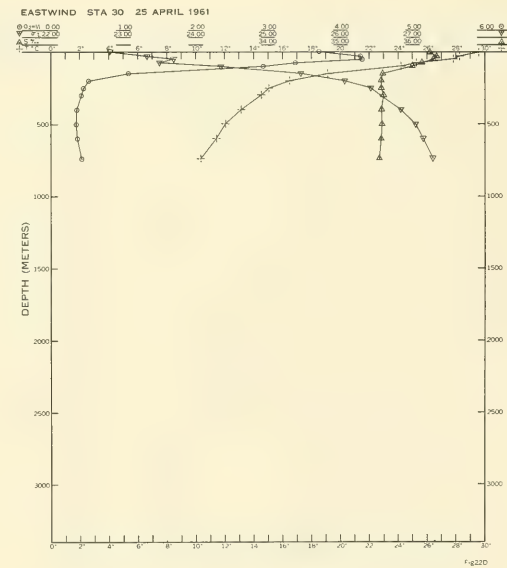
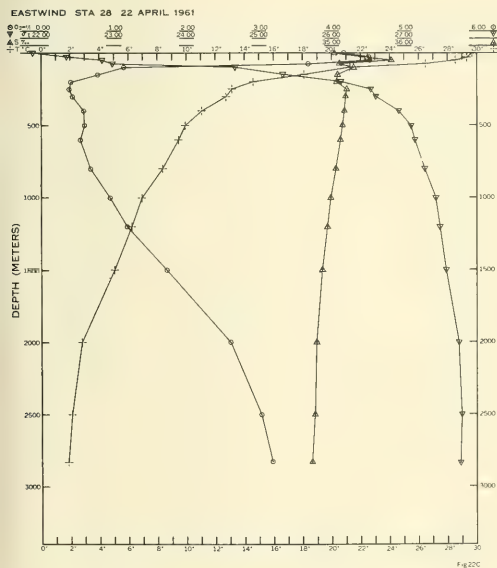
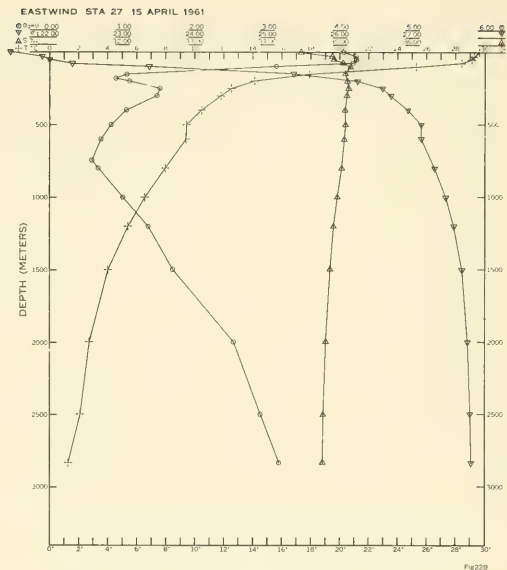
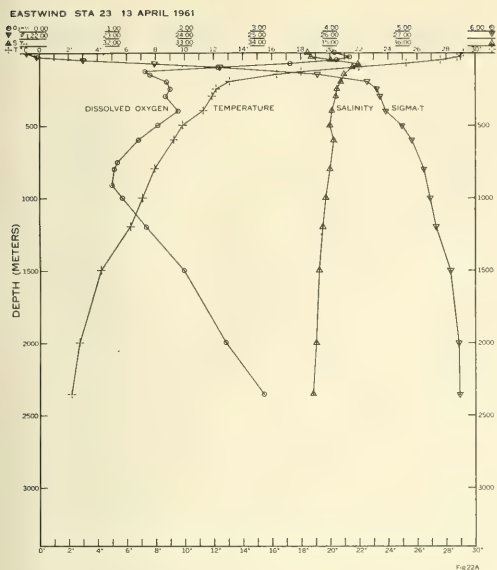


FIGURE 22. VERTICAL DISTRIBUTION OF TEMPERATURE, SALINITY, DENSITY (SIGMA-T), AND DISSOLVED OXYGEN AT STATIONS 23, 27, 28 and 30.

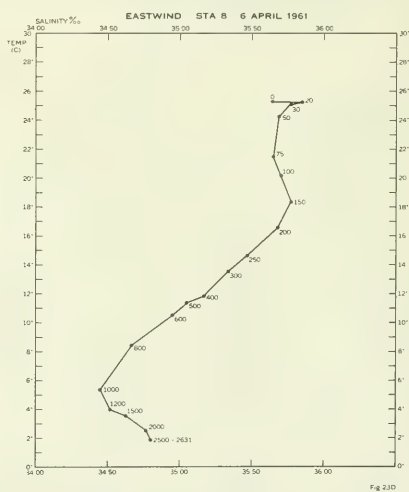
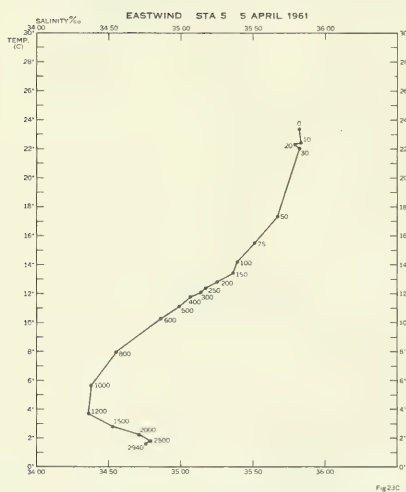
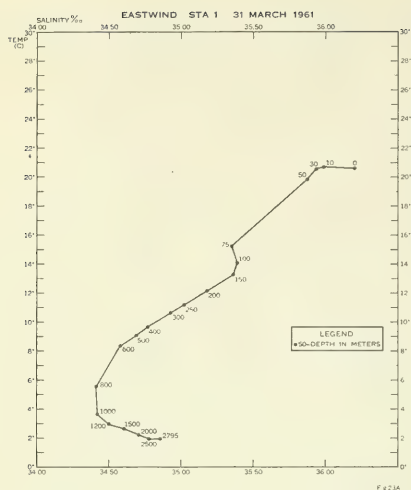


FIGURE 23. TEMPERATURE—SALINITY CURVE AT STATIONS 1, 3, 5, and 8.

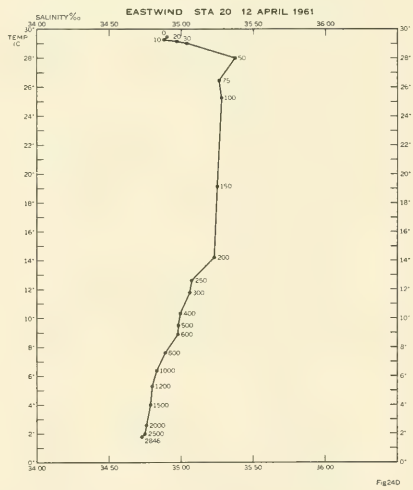
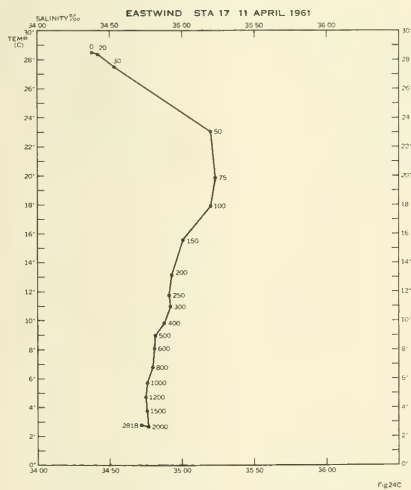
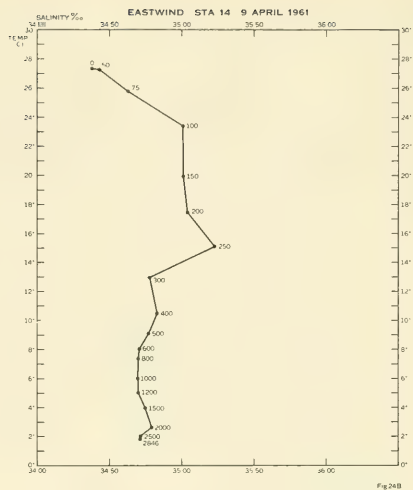
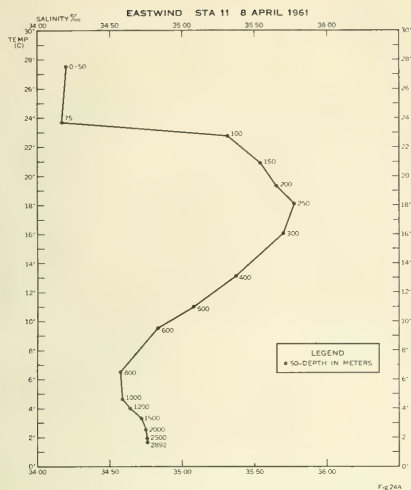


FIGURE 24. TEMPERATURE-SALINITY CURVE AT STATIONS 11, 14, 17 and 20.

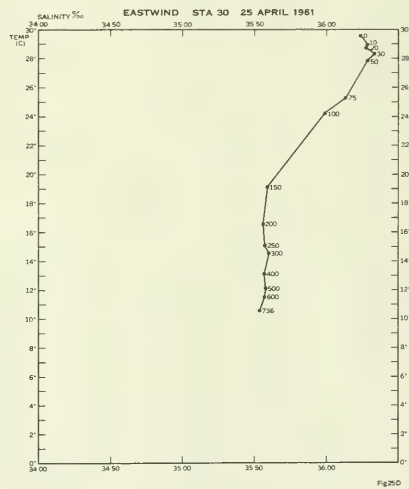
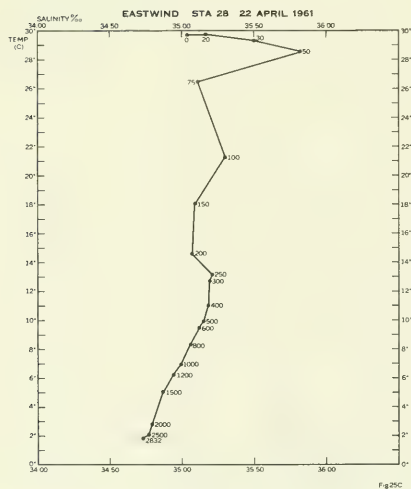
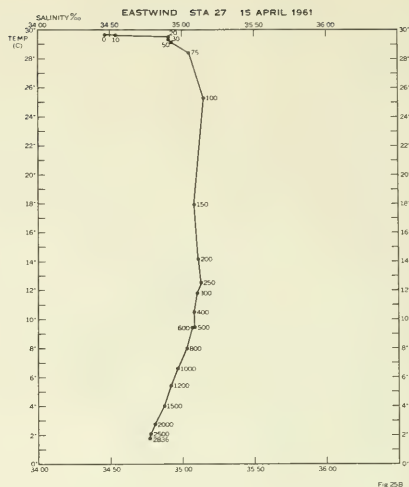
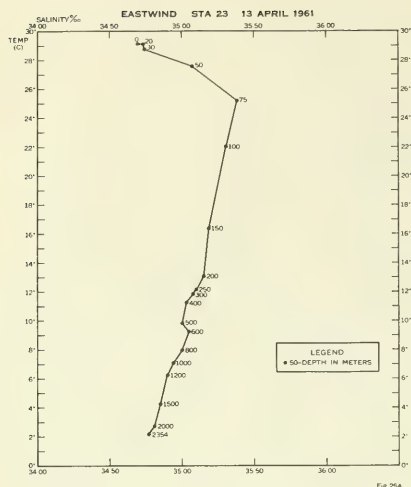


FIGURE 25. TEMPERATURE—SALINITY CURVE AT STATIONS 23, 27, 28 and 30.

IV. DISCUSSION OF RESULTS

The area of turbulence in the Indian Ocean, in the areas examined by EASTWIND, extended from the surface to a depth of about 50 meters, and in places somewhat deeper. As in other oceans, conditions in this region were fairly stable and uniform, but below this depth sudden and pronounced changes were encountered as the thermocline was reached. Below the thermocline at depths of from 200 to 600 meters, depending upon the geographic location, conditions tapered off slowly to the deepest observations. Despite the rough and variable bottom contour along the 32° S. parallel (Figs. 2 through 7), conditions did not show any striking trends. On the south-north profiles along the 78° E. meridian (Figs. 8 through 13), salinities and dissolved oxygen presented a complex pattern that indicated a divergence or upwelling between stations 11 and 16, at about 10° and 18° south latitude. The profiles constructed between stations 27 and 30 (Figs. 14 through 19), are somewhat artificial because of the wide spaces between stations and because of the existence of the Maldiv Islands between stations 27 and 28. For this reason, these two stations were connected by broken line isopleths. Also, station 30, off Socotra Island, was taken at a considerably shallower depth than most of the other stations; and, as a consequence, without intervening data, isopleths at the lower depths were shown as terminating at an indefinite point.

A. Temperature

As depicted in Figures 2 and 20, temperatures along the 32° S. parallel from 110° to 78° E. in the zone of turbulence showed only a slight increase toward the west. The comparatively shallower water between 96° and 102° E. was reflected slightly in the curves of the isotherms at depth; all isotherms below the turbulence zone remained roughly parallel to the surface. The thermocline (and here the word is used in its strictest sense, namely a sustained drop of at least 1°C. per 30 meters change in depth) was located between 30 and 50 meters down to a depth of only 100 meters as far as station 5. The 2° isotherm was found throughout this section at depths between 2200 and 2500 meters. Substantially the same temperatures at depth were observed by DIAMANTINA in 1959 (C.S.I.R.O., 1962) although her temperatures were somewhat lower (17° to 19°) in the zone of turbulence because of the time of year (November) at which the temperatures were taken.

The most interesting profile is the one starting at 32° S. latitude and running north along the 78° E. meridian to 4° N. latitude. This profile comprised 23 stations. (Fig. 8, 20, 21, and 22). Stations were occupied at 2° intervals as far north as 4° S. latitude and at 1° intervals from there to 4° N. latitude. In the zone of turbulence, which showed a slight increase in depth (from 30 to 75 meters) until 13° S. was reached, temperatures increased from

23.35° C. at the surface at station 5, to a maximum of 29.68° C. at the surface at station 27. Isotherms followed an irregular pattern which reflected no indication of the divergence between 10° and 18° S. latitude. The 2° isotherm, which started at station 5 at around 2300 meters, dropped slowly to a depth of almost 2600 meters at station 27. The thermocline (again employing the term in its strict interpretation) varied from about 30 to 50 meters (at station 27, it commenced at 75 meters) to a depth of 250 to 300 meters. Below the lower limit of the thermocline proper, temperature decreased in a more or less even curve to about 1500 to 2000 meters, below which there was only a slight decrease to the bottom of the cast.

Stations 27, 28, 29, and 30 have been connected together in a section which extends from west of Ceylon to off Socotra Island at the mouth of the Gulf of Aden. A profile along this section is shown in Figure 14, while the vertical distribution of temperature at three of the stations is given in Figure 22. The bottom, which at first is fairly even, becomes highly irregular between stations 29 and 30 and shallows greatly as Socotra Island is approached. The zone of turbulence in this section decreased in extent from station 27, where it extended from the surface to a depth of 75 meters, to 30 meters depth off Socotra Island. Isotherms to a depth of about 200 meters were roughly parallel with the surface; below that depth they tended to slope downward commencing with the 16° isotherm. The 2° isotherm was found between depths of 2600 and 2850 meters, and it dropped fairly sharply between stations 28 and 29. The thermocline was found between depths of 50 and 250 meters. Below the thermocline, temperatures followed a gently arched curve to 1500–2000 meters depth, a pattern similar to that observed at the other stations occupied.

The maximum temperature observed at any station was noted at station 28 on 22 April 1961 at the surface (29.71° C). The minimum temperature was noted at a depth of 2940 meters at station 5 on 5 April 1961 (1.66° C).

B. Salinity

Figures 3, 9, and 15 show profiles of sections giving salinity values with depth along the 32° S. parallel, the south-north track along the 78° E. meridian, and from station 27 to station 30 in the northern part of the Indian Ocean. Vertical distribution of salinity at selected stations is shown in Figures 20, 21, and 22. In general, salinity values followed closely those reported by Muromtsev (1959), variations from the general pattern being caused by the time of year at which observations were made. In observations made by EASTWIND, although there was clear evidence of Antarctic Intermediate water at depth, there was no indication of Antarctic Bottom water at any of EASTWIND's stations because of the fact that casts were made only to 3000 meters.

In Figure 3, it will be noted that surface salinity values appreciably decreased from 110° to 78° E. longitude along the 32° S. parallel. Values were higher near the Australian coast and decreased as the mid-Indian Ocean area was approached. They were all well above 35.00‰ and at the easterly portion exceeded 36.00‰. In November 1959, DIAMANTINA reported almost completely uniform salinities at the surface of the order of magnitude of 35.86‰, along this parallel from 110° to 95° E. longitude (C.S.I.R.O., 1962). Isohalines were generally parallel with the surface, and salinity values decreased with depth to the 800 to 1000 meters level. At this stratum, a region of low salinity was encountered which extended some 300 meters downward. The position of this mass of low salinity water was at a somewhat higher level at the eastern end of the profile. This mass probably represented Antarctic Intermediate water from the south. Below the layer of low salinity, values increased towards the bottom. The region of low salinity also showed up in DIAMANTINA's data for the same area.

Vertical distribution of salinity is shown in Figure 20 for stations 1, 3, and 5. Here, in each case the salinity curve rather closely followed the temperature curve. The high salinity water to the east in the zone of turbulence and the intermediate layer of low salinity at 1000 meters are prominent.

Figure 9 represents a profile of salinity values from station 5 to station 27, or from 32° S. to 4° N. latitude along the 78° E. meridian. The most striking feature of this figure is the large mass of Antarctic Intermediate water of low salinity which pushed its way up from the south at depth and extends as far north as 10° S. latitude. It was probably this mass of water which caused the disturbance between 10° and 18° S. latitude. Water with a salinity of 35.00‰ or higher, which it is presumed, originated in the Arabian Sea area, can be seen to the right in the figure. This water extended in general from around 900 meters upwards to the zone of turbulence. A pocket of high salinity water was found just below the zone of turbulence between 11° S. and 2° N. Between 10° S. and 17° S. the low salinity, Antarctic Intermediate water, having a lower density, pushed the northern high salinity water closer to the surface and formed an upwelling or divergence. This upwelling is also evident in Figure 11, which shows the distribution of dissolved oxygen. There the Antarctic Intermediate water has a higher oxygen content than the Indian Ocean water. South of 19° S. somewhat higher salinities prevailed at the surface and throughout the zone of turbulence.

The vertical distribution of salinity at selected stations along the 78° E. meridian is shown in Figures 20, 21, and 22. As far north as station 8, (Fig. 20D), salinity follows the temperature curve fairly closely, but at station 11, (Fig. 21A), there is a sharp increase in salinity values below the zone of turbulence. Below 800 meters depth there was little change in salinity to the bottom of the cast. At

station 14 (Fig. 21B), the salinity curve sharply decreased between 100 and 300 meters, and from the latter depth showed only slight change to the bottom of the cast. At station 17, (Fig. 21C), the patch of high salinity water was encountered at 75 meters, and below the lower margin at 200 meters depth, conditions were relatively uniform to the bottom of the cast. At station 27 (Fig. 22B), the most northerly of this section, 35.00‰ water extended down as far as 900 meters. There was a slight increase from this point to the zone of turbulence where the salinity dropped to 34.47‰ at the surface.

In Figure 15 isohalines for stations 27, 28, 29, and 30 are shown. At the surface, there is a definite increase in salinity as the mid-Arabian Sea is approached, and this is accelerated near the Red Sea outlet at the Gulf of Aden. Furthermore, high salinity water, both from the Arabian Sea and from the Red Sea, penetrated deeper in the western end of the section. Water with salinity values of 35.00‰ or higher was found to a depth of 900 to 950 meters at station 27 (Fig. 22B), whereas at station 29 (Appendix A) it had descended below 1400 meters. Station 30 south of Socotra Island was considerably shallower than any of the other stations occupied but, nevertheless, showed the highest salinity values of any station observed because of its location in the center of the Red Sea outflow.

The vertical distribution of salinity at stations 27, 28, and 30 is shown in Figure 22 (B, C, and D). The curves for stations 27 and 28 are similar below the zone of turbulence. At station 30, however, the extremely high salinity water from the Red Sea reached a depth of 150 meters, and, from this depth to the bottom, a uniform condition of somewhat lower salinity (around 35.60‰) prevailed.

The meaning of the distribution of salinity values and their relation to the various other masses comprising the water of the Indian Ocean will be discussed in the next section under Temperature-Salinity relations. Identification of water masses can be made by salinity content. These results are further borne out by dissolved oxygen values which will be discussed in a later section.

C. Temperature-Salinity Relations

Figures 23, 24, and 25 depict the vertical distribution of temperature plotted against salinity. In Figure 23, (A, B, and C), T-S curves for stations 1, 3, and 5 along the 32° S. parallel are presented. The curves are very similar. At station 1, warm, highly saline, and less dense water was present in the zone of turbulence down to around 30 meters depth. This station was close enough to the Australian coast to be affected by the warm water current that sets south along the coast; however, only the upper waters appear to be affected by this current. Below 30 meters to about 150 meters, the waters gradually cooled and

salinity decreased. This layer is known as the Subtropical Surface Water Layer. From 150 meters down to 600 meters Indian Central Water was present. Below 600 meters the effect of the Antarctic Intermediate water was beginning to be felt, while between 600 and 1000 meters the station was in the Antarctic Intermediate water proper with low salinity. Below 1000 meters salinity increased toward the bottom of the cast while temperature dropped. The Antarctic Intermediate water is thus represented here by a tongue of low salinity water at mid-depth. It is formed at the Antarctic Convergence; there water of comparatively low salinity and temperature sinks, and the greater portion of it flows toward the north forming tongues of Antarctic Intermediate water at mid-depth which can be traced for long distances in all the oceans. Presence of Antarctic Intermediate water is also graphically portrayed in Figure 3, between depths of about 500 to 1300 meters.

The T-S curve at station 3 shows no influence of the warm coastal current along the western coast of Australia, since this station was 8 degrees farther west. Otherwise, water masses appear about as they did at station 1. The Antarctic Intermediate water extends from about 800 to 1200 meters. At station 5, Antarctic Intermediate water is found between 1000 and 1200 meters although a glance at Figure 23C will show that while the core of this mass is at 1200 meters the body extends down to around 1500 meters. Following the tongue of Antarctic Intermediate water further north on the south-north profile (Fig. 3), it will be seen that the core successively rises from 1200 meters at station 5, to 1000 meters at station 8, 800 meters at stations 11, 14, and 16.

The formation at the top of the T-S curve at station 8 (Fig. 23D) appears to be an anomaly. Possibly heavy local rainfall caused the fresher water layer to occur in the top 20 meters. EASTWIND had experienced rain neither at this station nor before arriving there. However, sudden, heavy rain squalls are frequent in these parts and are usually of very local extent. Between 20 meters and 150 meters there is Subtropical Surface water. Indian Central water is found between 150 and something under 1000 meters. Antarctic Intermediate water appears on the T-S curve between 1000 and 1200 meters.

In Figure 24A, at station 11, surface salinity had decreased sharply because of less evaporation that resulted from the increased humidity and because of the low salinity water that was brought in by the South Equatorial Current from the Malay Archipelago. An extremely sharp salinity gradient is noted between 75 and 100 meters. Below 100 meters is a fairly thin layer of Subtropical Surface water. The Indian Central water begins at about 250 meters and continues to 800 meters. Antarctic Intermediate water on the curve in Figure 24A for station 11 is between 800 and 1000 meters. Station 14 shows a T-S curve which is similar to that at station 11; the low salinity water in the upper 100 meters is from the South Equatorial Current. Below this down to 250 meters is subtropical

Surface water, and from 250 to about 600 meters is Indian Central water. The Antarctic Intermediate water had become mixed with other water and salinity had increased; however, there are some indications of this water on the T-S curve and also on Figure 9 below 600 meters.

By the time station 17 was reached, the last traces of Antarctic Intermediate Water had been left behind (Fig. 24C). The upper 50 meters contains low salinity water from the Malay Archipelago. Subtropical Surface water extends from 50 to 100 meters, and below this is the Indian Central water mass. Station 20 (Fig. 24D), shows a T-S curve similar to that at station 17. At station 23 on Figure 25A, there is an isothermal mixed surface layer. Below that, from 20 to 75 meters is Malay Archipelago water, and below that to about 500 meters Indian Central water.

Station 27, shown on Figure 25B, was taken on 15 April, with the season progressing toward maximum air temperatures in May. The top, almost isothermal, mixed, surface layer shows this. Below this, to 250 meters, is the thermocline circulation. Indian Central water is found below 250 meters. Station 28 (Fig. 25C), occupied on 22 April shows further evidence of approaching high air temperatures in the top 50 meters. From 50 meters to 200 meters the Indian Equatorial water mass is present. From 200 meters down to about 1000 meters the effect of Red Sea water is evident, with the cooler, less saline water below this level. At station 30, influence of Red Sea water is pronounced in the top 150 meters. Below 150 meters the water mass is Indian Equatorial water.

A series of 22 surface salinity samples taken from the southern entrance to the Red Sea at 12° 27' N., 44° 09' E. to the extreme end at 28° 45' N., 32° 57' E. (Table I), showed a steady and at most times regular salinity increase. Salinity (36.27‰) at the first sample location was almost exactly that found at survey station 30. This was apparently normal surface salinity for the greater part of the Gulf of Aden because of the broadening out of the water area after it passes the strait of Bab el Mendab. Half way up the Red Sea proper, salinity had reached 39.00‰, and 40.00‰ was attained before entering the narrow portion near the northern end. The highest salinity observed was at the most northern collection point. It was 41.57‰.

TABLE I. SALINITY VALUES AT THE SURFACE IN THE RED SEA, APRIL 1961

POSITION		SALINITY	WATER TEMPERATURE
Latitude	Longitude	(‰)	(F.)
12°27'N	- 44°09'E	36.27	83.0
12°48'N	- 43°17'E	36.40	83.3
13°43'N	- 42°57'E	36.41	82.6
14°27'N	- 42°27'E	36.82	82.0
15°15'N	- 41°58'E	36.75	81.5
16°05'N	- 41°27'E	37.50	81.9
16°55'N	- 40°56'E	37.36	82.2
18°00'N	- 40°17'E	37.43	82.9
18°34'N	- 39°56'E	38.06	83.2
19°21'N	- 39°26'E	38.38	82.9
20°08'N	- 38°50'E	39.00	82.2
20°56'N	- 38°16'E	39.11	81.0
21°44'N	- 37°43'E	38.80	80.9
22°33'N	- 37°15'E	39.66	78.7
23°21'N	- 36°46'E	39.84	78.8
24°09'N	- 36°16'E	39.55	78.3
25°00'N	- 35°43'E	40.43	74.8
25°50'N	- 35°13'E	40.26	75.0
26°37'N	- 34°44'E	40.42	73.4
27°19'N	- 34°16'E	40.48	73.0
27°19'N	- 33°33'E	40.80	72.8
28°45'N	- 32°57'E	41.57	69.0

D. Density

In Figure 4, the profile of density distribution with depth between stations 1 and 5 shows no startling features. In the zone of turbulence density decreased from east to west about one unit of sigma-t. At 50 meters depth, however, density remained nearly constant at around 26.00, and, as normally occurs, density increased with depth. The 27.00 isopleth was between 700 and 900 meters between these stations.

The profile of density distribution with depth, between stations 5 and 27 (Figure 10), shows a decided drop in density at the surface and in the zone of turbulence from south to north. Rising water temperatures are responsible for the lower densities. Commencing at about 50 meters depth, the 26.00 isopleth drops to 90 meters at station 8 and to 270 meters at station 11. North of this point, this isopleth is pushed upward by the tongue of water of lower salinity (Antarctic Intermediate water). By station 18, it has reached 150 meters depth, and from this point (5° S.) north, it remains at only a few meters below this level. The 27.00 isopleth shows considerably more of the effects of the tongue of Antarctic Intermediate water than the others. Starting at a depth of 850 meters at station 5, it is pushed up to a little under 500 meters at station 13 (16° S.) With minor up and down variations, it follows approximately this depth to the northern end of the section.

Between stations 28 and 30 (Fig. 16), there was a slight increase at the surface. This was caused by increasing salinity as the Red Sea was approached. The 26.00 isopleth almost constantly remains at a depth of about 175 meters, while the 27.00 isopleth only varies from 430 to 465 meters depth.

E. Dissolved Oxygen

The distribution of dissolved oxygen with depth between stations 1 and 5 is shown in Figure 5. Vertical distribution at selected stations along the 32° S. parallel is shown in Figure 20, A, B, and C. There was no apparent trend in the upper waters, but from around 1200 to 2000 meters a tongue of water with low oxygen extended from the east and became mixed as mid-Indian Ocean areas were reached at station 5. This is the characteristic low oxygen layer underlying Antarctic Intermediate water, which is comparatively high in oxygen. There was also water containing more oxygen below the low oxygen tongue that extended to the bottom of the casts.

In Figure 20, A, B, and C, vertical distribution curves for dissolved oxygen at stations 1, 3, and 5 are similar, and roughly follow the temperature curve below the zone of turbulence. The layer of low oxygen from the surface to 50 meters depth was apparently a result of the western coastal current of Australia.

Figure 11 shows the vertical distribution of dissolved oxygen with depth between stations 5 and 27 (32° W. and 4° N. along the 78° E. meridian). The most striking feature of this profile is the large mass of low oxygen water in the north which came in from the Arabian Sea and, to a lesser extent, from the Red Sea. To the south of the profile, this water pushed the high oxygen water upwards. Mixture of the two is clearly shown. The disturbed condition between 10° and 18° S. is also shown as in the salinity profile for the same stations.

In Figures 20, 21, and 22, the vertical distribution of dissolved oxygen at selected stations along this south-north section is shown. The effect of the large body of low oxygen water is evident from the highly irregular form of the curve.

Figure 17 shows the vertical distribution of dissolved oxygen between stations 27 and 30. In the zone of turbulence, oxygen values were average, but below this depth values decreased rapidly. At station 28, the lowest values were observed. The lowest, 0.39 ml/l, occurred at 250 meters depth. Below a depth of from between 1000 and 1200 meters, where the 1.00 ml/l isopleth is shown in this profile, oxygen values increased steadily toward the bottom of the casts.

In Figure 22 B, C, and D, the vertical distribution of dissolved oxygen is shown for stations 27, 28, and 30. The very low oxygen values observed at station 28 again stand out in the peculiarly shaped curve. Station 30 shows an entirely different type of oxygen curve as values decrease very rapidly below the zone of turbulence in the layer between 100 and 200 meters, and then remain almost without change from this depth to the bottom.

F. Percentage of Saturation of Dissolved Oxygen

Supplementing a knowledge of the actual values of dissolved oxygen in oceanic waters, it is of interest to know just how much oxygen is dissolved in comparison with the amount the water could hold under standard pressure at the temperature observed. Percentages of saturation less than maximum (100%) invite questions as to why the water is not saturated, and these questions are not always easy to answer. Temperature is involved because cold water will hold more dissolved gas than warm water. Currents which bring water of low or high oxygen from other regions often account for high or low saturation percentages. Abundance or scarcity of phytoplankton or a superabundance of oxygen consuming plankton are factors to be taken into consideration. When favorable conditions prevail such as calm, clear weather, bright sunshine, and abundant phytoplankton, supersaturation in the upper waters may result. With a transparent, snowless ice cover, percentages of supersaturation as high as 300% have been noted in inland lakes.

Figures 6, 12, and 18, show vertical distribution of percentage of saturation

of dissolved oxygen. It will be noted that in general the isopleths follow very closely those for actual dissolved oxygen values (Figs. 5, 12, and 17). In Figure 6, percentages along the 32° S. parallel are shown. Saturation or slight supersaturation can be observed at the surface and in the zone of turbulence where the water was well mixed by wind and waves, and where the water was in contact with the air. Below the zone of turbulence, percentages of saturation decreased; the lowest values occurred below the level of the Antarctic Intermediate water. Here, at between 1200 and 2000 meters depth there was only 50% saturation. Saturation percentages increased below these depths as far as the bottom of the cast.

As shown in Figure 12, dissolved oxygen saturation percentages at and near the surface, which commenced at 32° S. latitude at saturation point, declined somewhat as observations reached areas farther to the north. The 100% isopleth remains well within the zone of turbulence as far north as about 16° S. Here it terminates at the surface, and beyond this point complete saturation was never regained. The advancing season with higher air temperatures and water temperatures, plus low oxygen water from the Arabian Sea accounted for the decrease in saturation as one progresses northward. The large mass of low saturation water coming in from the Arabian Sea and pushing under the upper waters is clearly shown in Figure 12. Dissolved oxygen saturation reached a low at 800 meters depth at station 27 (10%). The 10% isopleth continues at a depth of 800 meters westward (as shown in Fig. 18) past station 29. At station 30, however, it rises sharply to the 200 meter level. Surface waters attained 100% saturation only at station 28, and there was a noticeable decrease westward. Red Sea water accounted for the low saturation percentages found at station 30 where, below 150 meters, saturation was less than 10%. The lowest saturation percentages (6%) were found at station 28 at 240 meters depth and at station 30 between 400 and 600 meters. Although dissolved oxygen saturation percentages increased toward the bottom of the cast east of station 30, a high saturation value was never attained. Mixing of the low oxygen water originating in the Red Sea accounted for this.

G. Sound Velocity

Figure 7 shows vertical distribution of sound velocity between station 1 and 5. At and near the surface, sound velocity is greatest at the western or mid-Indian Ocean end of the profile. The actual value reached slightly more than 5000 feet/second. A sound channel where the velocity has decreased to 4851 to 4866 feet/second, is located at a depth of 800 meters at station 2 but drops to 1200 meters at the next station and continues at this level to the end of the profile at 78° E. longitude.

Vertical distribution of sound velocity between station 5 and 27 is shown in Figure 13. Sound velocity at the surface increases toward the north because of

salinity increase. A sound channel, which starts out at 32° S. latitude in the tongue of Antarctic Intermediate water at a depth of 1200 meters, ascends to 1000 meters at station 11 (20° S. latitude) as it follows the tip of the tongue toward the surface. North of the divergence, the sound channel again drops to 1200 meters and continues at 1200 meters as far as 6° S. At the equator, the sound channel has descended to 1500 meters and with slight variation, maintains approximately this level to the end of the profile.

Sound velocity between stations 27 and 30 (Fig. 19) shows almost no change at or near the surface. Isopleths are nearly parallel with the surface until the 4925 line, which dips sharply downward west of station 29. This dip is reflected in the location of the sound channel which rises from 1500 to 1100 meters at station 28 and then drops to 1400 meters at station 27.

H. Transparency

Secchi disc transparency was determined whenever light conditions permitted; 18 out of the 30 stations include such observations. On the southern 32° S. section three transparency readings averaged 29.5 meters and ranged from 25 to 38.7 meters. On the south-north section 12 transparencys averaged 25 meters with a range between 22 and 30 meters. Three transparencys taken at stations 28, 29, and 30, averaged 30 meters with a range of between 27 and 38 meters. The highest or best transparency observed was at station 4 (38.7 meters) and second highest or best was at station 28 (38 meters). Thus, an average of all stations measured in the Indian Ocean comes to about 26 meters transparency.

I. Deep Scattering Layer

The deep scattering layer was followed by observing the fathometer trace three times per day, and it remained between depths of between 100 and 300 fathoms until the evening of 1 April at about 104° E. longitude. That evening it was weak at 250 fathoms and was not observed again until 11 April at latitude 8° S., when it reappeared on the trace at between 200 and 400 fathoms. It was evident also at that time that at least part of the DSL had come to the surface because of the abundance of lumenescent ctenophores, fish, and squid that were dashing around under the powerful winch light, when stations were taken at night. The DSL continued on into the waters off Ceylon, and it was followed across the northern Indian Ocean but disappeared in the Red Sea.

The disappearance of the Deep Scattering Layer in mid-Indian Ocean and its reappearance near the Indian coast duplicate its performance in the Pacific Ocean where this phenomenon has been observed several times en route to New Zealand from Panama. It is the author's belief that no DSL exists in mid-ocean because of the scarcity of plankton, hence scarcity of plankton feeders, squid, and fish.

V. ACKNOWLEDGMENTS

It is a pleasure to acknowledge the cooperation of the U. S. Coast Guard, Captain J. W. Naab, in command of the EASTWIND, his officers and crewmen, who made possible the collection of the data discussed above. When it is considered that the taking of 30 ocean stations added several days to the length of the cruise and to the lateness of arrival in Boston, EASTWIND's home port, and that the ship and crew had already been away from home many months, it is especially gratifying to recall the willingness with which each man assisted in the program to the best of his ability. The author can recall no complaints whatsoever about the part the oceanographic program was playing in delaying final anchor time in Boston, and this is an unparalleled situation in his experience.

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APPENDIX A

OCEANOGRAPHIC STATION DATA

NODC REFERENCE NUMBER 00599

EXPLANATION OF OCEANOGRAPHIC STATION DATA

A. General

Each of the items appearing on the data pages is explained below. The vertical arrows shown in some of the column headings indicate the location of decimal points. The presence of asterisks to the right of data indicates those data are doubtful; hence, they were not used in the construction of the curve from which interpolated values (standard depth values) were derived. Observed values which were obviously invalid were omitted entirely.

B. Surface Observations

1. NODC Ref.No. This number is arbitrarily assigned. It identifies the cruise and provides a means of sorting from the IBM files all cards pertaining to that particular cruise. A cruise number for each ship is presented on the flysheet for the tabulated oceanographic data.

2. Station Number. Stations are numbered to designate a certain station location; however, stations are presented in the chronological order in which they were occupied.

3. Date. Month and day are given in Arabic numerals. The last three figures of the year are indicated. The hour is Greenwich Mean Time and is that hour nearest to the start of the first cast.

4. Latitude and Longitude. The position of the station is given in degrees and minutes.

5. Sonic Depth. Sonic Depth is the uncorrected sounding for the station, recorded in meters.

6. Maximum Sample Depth. The maximum depth from which a water sample was obtained at the station is given to the nearest 100 meters.

7. Wind. Wind speed is given in meters per second. Direction from which the wind blows is coded in degrees true to the nearest ten degrees. The last zero is omitted. North is 36 on this scale and calm is 0. See Table 1, Compass Direction Conversion Table for Wind, Sea, and Swell Directions.

8. Anemometer Height. The height of the anemometer above the waterline is given in meters.

9. Barometric Pressure. Barometric pressure is coded in millibars, neglecting the 900 or 1000. Thus, 996 millibars is coded as 96 and 1008 millibars is coded as 08.

10. Air Temperature. Dry bulb and wet bulb temperatures are entered to the nearest tenth of a degree Celsius ($^{\circ}\text{C}$). A negative temperature is coded by dropping the minus sign and adding 50; thus -10° is coded as 60.

11. Humidity. The percent of humidity is coded directly, 100 percent being coded as 99.

12. Weather. Weather is coded as indicated in Table 2, Numerical Weather Codes - Present Weather.

13. Cloud. Cloud type and amount are coded as indicated in Tables 3, Cloud Type, and 4, Cloud Amount.

14. Sea. Sea direction and amount are coded as indicated in Tables 1 and 5, respectively.

15. Swell. Swell direction and amount are coded as indicated in Tables 1 and 6, respectively.

16. Visibility. Visibility is coded as indicated in Table 7, Visibility.

C. Subsurface Observations

1. Sample Depth. Observed (actual) depth of each sample is given in meters. Interpolated values at standard depths are also given. The standard depths, in meters, are: 0, 10, 20, 30, 50, 75, 100, 150, 200, 250, 300, 400, 500, 600, 800, 1000, 1200, 1500, 2000, 2500, 3000, and thence every 1000 meters.

2. Temperature. The Celsius ($^{\circ}\text{C}$) temperature is given in degrees and hundredths.

3. Salinity. Salinity is given in parts per thousand (by weight) to two decimal places.

4. Sigma-t. To convert to density divide by 1000 and add 1. Thus, a sigma-t value of 22.35 converts to a density of 1.02235.

5. Delta-D. The values in the columns are the anomalies of dynamic depths from the surface to each level in dynamic meters. Each entry is the cumulative sum of the anomalies of dynamic depth of the layer above. These values have been computed for the standard depths only, and serve to identify computed points.

6. Dissolved Oxygen. These values when given are in milliliters per liter to two decimal places. Values of 10.00 or above rarely occur and are coded as 9.99.

7. Sound Velocity¹. Sound velocity is given in feet per second to one decimal place, corrected for pressure at each depth. See footnote 1 on page 6.

TABLE 1. COMPASS DIRECTION CONVERSION TABLE FOR WIND, SEA, AND SWELL DIRECTIONS

<u>Code</u>	<u>Direction</u>	<u>Code</u>	<u>Direction</u>
00	Calm	19	185° to 194°
01	5° to 14°	20	195° to 204° SSW
02	15° to 24° NNE	21	205° to 214°
03	25° to 34°	22	215° to 224°
04	35° to 44°	23	225° to 234° SW
05	45° to 54° NE	24	235° to 244°
06	55° to 64°	25	245° to 254° WSW
07	65° to 74° ENE	26	255° to 264°
08	75° to 84°	27	265° to 274° W
09	85° to 94° E	28	275° to 284°
10	95° to 104°	29	285° to 294° WNW
11	105° to 114° ESE	30	295° to 304°
12	115° to 124°	31	305° to 314°
13	125° to 134°	32	315° to 324° NW
14	135° to 144° SE	33	325° to 334°
15	145° to 154°	34	335° to 344° NNW
16	155° to 164° SSE	35	345° to 354°
17	165° to 174°	36	355° to 4° N
18	175° to 184° S	99	Variable or unknown

TABLE 2. NUMERICAL WEATHER CODES—PRESENT WEATHER

00	01	02	03	04	05	06	07	08	09
Cloud development, but not observed during past hour.	Clouds develop, but not observed during past hour.	Sales only, but not observed during past hour.	Clouds develop, but not observed during past hour.	Visibility reduced by snow.	Haze.	Widespread dust or sand in suspension in the air, but NOT raised by wind at observation time of observation.	Dust or sand raised by wind, at time of observation.	Well covered dust devil(s) within past hour.	Dust storm or sand storm within sight of station during past hour.
10	Patches of shallow fog, but not at time of observation.	More or less continuous fog, but not at time of observation.	Lightning visible, no thunder heard.	14	15	16	17	18	19
20	Rain (NOT freezing and NOT falling as snow) during past hour, but NOT at time of observation.	22	23	24	25	26	27	28	29
30	Slight or moderate dust storm or sand storm during past hour.	32	33	34	35	36	37	38	39
40	Fog at distance at time of observation, but NOT at station during past hour.	42	43	44	45	46	47	48	49
50	Intermittent drizzle (NOT rain) at time of observation.	52	53	54	55	56	57	58	59
60	Intermittent rain (NOT rain) at time of observation.	62	63	64	65	66	67	68	69
70	Intermittent fall of snowflakes, slight at time of observation.	72	73	74	75	76	77	78	79
80	Slight rain shower(s).	82	83	84	85	86	87	88	89
90	Moderate or heavy shower or rain at time of observation.	92	93	94	95	96	97	98	99

TABLE 3. CLOUD TYPE

Code

0	Stratus or Fractostratus
1	Cirrus
2	Cirrostratus
3	Cirrocumulus
4	Alto cumulus
5	Altostratus
6	Stratocumulus
7	Nimbostratus
8	Cumulus or Fractocumulus
9	Cumulonimbus

TABLE 4. CLOUD AMOUNT

Code

0	No clouds
1	Less than 1/10 or 1/10
2	2/10 and 3/10
3	4/10
4	5/10
5	6/10
6	7/10 and 8/10
7	9/10 and 9/10 plus
8	10/10
9	Sky obscured

TABLE 5. SEA AMOUNT

Code	Mean Max. Height of Sea Waves in feet (Approx.)	Description
0	0	Calm (glassy)
1	0 - 1/3	Calm (rippled)
2	1/3 - 1 2/3	Smooth (wavelets)
3	1 2/3 - 4	Slight
4	4 - 8	Moderate
5	8 - 13	Rough
6	13 - 20	Very rough
7	20 - 30	High
8	30 - 45	Very high
9	over 45	Phenomenal ⁺

+ As might be expected in center of hurricane

TABLE 6. SWELL AMOUNT

Code	Approximate Height (feet)	Description		Approximate Length (feet)
0	----	No swell		----
1	1 to 6	Low swell	Short or Average	0 to 600
2			Long	Above 600
3	6 to 12	Moderate	Short	0 to 300
4			Average	300 to 600
5			Long	Above 600
6	Greater than 12	High	Short	0 to 300
7			Average	300 to 600
8			Long	Above 600
9	----	Confused		----

TABLE 7. VISIBILITY

Code

0	Dense fog -----	50 yards
1	Thick fog -----	200 yards
2	Fog -----	400 yards
3	Moderate fog -----	1000 yards
4	Thin fog or mist -----	1 mile
5	Visibility poor -----	2 miles
6	Visibility moderate -----	5 miles
7	Visibility good -----	10 miles
8	Visibility very good -----	30 miles
9	Visibility excellent -----	Over 30 miles

TABLE 8. WATER COLOR

Code (Percent yellow)Description

00 -----	Deep blue
10 -----	Blue
20 -----	Greenish-blue (or green blue)
30 -----	Bluish-green (or blue green)
40 -----	Green
50 -----	Light Green
60 -----	Yellowish-green
70 -----	Yellow green
80 -----	Green yellow
90 -----	Greenish-yellow
99 -----	Yellow

D. Additional information given on each station data sheet includes:

- (1) The number of casts taken, the wire angle observed, the number of Nansen bottles used, and the type thermometers used.
- (2) The number of protected thermometers considered to have functioned properly. (Indicated as accepted).
- (3) The number of unprotected thermometers considered to have functioned properly. (Indicated as accepted when the computed thermometric depth was within $\pm 1\%$ of the accepted depth between 0 and 1000 meters and $\pm 0.5\%$ of the accepted depth below 1000 meters.)

Table 9 gives a summary of the paired protected thermometer readings for cruise 00599.

Table 9. SUMMARY OF PAIRED PROTECTED THERMOMETER READINGS,
CRUISE 00599.

Total Number of Pairs Used During Cruise	DIFFERENCE °C. BETWEEN PAIRED THERMOMETERS Accepted and Averaged								One Thermometer of Pair Not Accepted
	.00	.01	.02	.03	.04	.05	.06	>.06	
391	39	78	68	41	41	26	11	12	75*
% of Total	10.	19.9	17.4	10.5	10.5	6.6	2.8	3.1	19.2

* Both readings of one pair were rejected.

Consec. Sta. No. 1		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0001	03	31	1961	04	32	00' S	110	00' E	5029	28

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
07	20		14	17 3	14 3		02	4	6	22	3			7	00	25

		SUBSURFACE OBSERVATIONS									
		DEPTH (M)	T °C	S ‰		σ _t		Σ ΔD	Q _{2m} l/l	V _t	
			↓	↓		↓	↓	↓			↓
STD	0000	20	65						5	02	
ORS	0000	20	65	36	20*	25	52*		5	02	4993 0*
STD	0010	20	64						5	03	
ORS	0010	20	64	35	99*	25	36*		5	03	4992 8
ORS	0019	20	62	35	93	25	32		5	02	4992 9
STD	0020	20	61	35	93	25	33		5	03	4992 9
ORS	0029	20	54	35	93	25	34		5	09	4992 8
STD	0030	20	53	35	93	25	35		5	09	4992 7
ORS	0048	20	41	35	94	25	39		5	14	4992 8
STD	0050	19	85	35	87	25	48		5	28	4987 5
ORS	0072	15	43	35	34	26	16		6	31	4943 8
STD	0075	15	24	35	35	26	21		6	31	4942 0
ORS	0097	14	15	35	39	26	47		6	29	4932 0
STD	0100	14	11	35	39	26	48		6	21	4931 7
ORS	0145	13	41	35	38	26	62		5	44	4926 8
STD	0150	13	30	35	36	26	63		5	44	4925 8
ORS	0193	12	36	35	21	26	70		5	48	4917 3
STD	0200	12	18	35	18	26	71		5	50	4915 6
ORS	0242	11	30	35	03	26	76		5	58	4907 5
STD	0250	11	21	35	02	26	77		5	60	4906 9
ORS	0291	10	76	34	95	26	80		5	65	4903 8
STD	0300	10	65	34	93	26	80		5	63	4903 0
ORS	0368	09	93	34	80	26	83		5	52	4898 0
STD	0400	09	70	34	77	26	84		5	54	4897 0
ORS	0460	09	30	34	72	26	87		5	58	4895 5
STD	0500	09	11	34	69	26	88		5	41	4895 4
ORS	0553	08	76	34	64	26	89		5	24	4894 1
STD	0600	08	39	34	58	26	91		5	17	4892 0
ORS	0645	07	91	34	53	26	94		5	06	4888 5
ORS	0737	06	51	34	45	27	07		4	68	4875 7
STD	0800	05	60	34	41	27	16		4	63	4867 3
ORS	0922	04	20	34	39	27	30		4	42	4855 5
STD	1000	03	66	34	42	27	38		4	11	4852 8
ORS	1107	03	03	34	46	27	47		3	80	4850 5
STD	1200	02	95	34	50	27	51		3	73	4855 0
ORS	1385	04	39*	34	57	27	42*		3	64	4886 4*
STD	1500	02	68	34	61	27	62		3	67	4869 5
ORS	1852	02	38	34	70	27	72		3	76	4886 4
STD	2000	02	22	34	71	27	74		3	79	4892 9
ORS	2321	01	99	34	74	27	79		3	89	4908 7
STD	2500	01	97	34	78	27	82		3	97	4919 2
ORS	2795	01	95	34	86	27	89		4	14	4936 7

Sta. No.
1

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	15°	11	20	17	2	0
II	25°	11	17	15	5	1

Consec. Sta. No. 2		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0002	04	01	1961	14	32° 00' S	102° 00' E	3383	20		

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMIDITY	WEATHER	CLOUD		SEA		SWELL		VIS	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR	AMT	DIR	AMT.		COL.	TRANS
07	27		20	19.8	17.8			50	8	5	26	2		7	00	

SUBSURFACE OBSERVATIONS									
SAMPLE DEPTH (M)		T °C	S‰	σ _t ↓	Σ ΔD	O ₂ ml/l	V _t ↓		
STD	0000	20 02	35 90	25 46	0 000	5 27	4986 2		
OBS	0000	20 02	35 90	25 46		5 27	4986 2		
STD	0010	20 03	35 91	25 47	0 025	5 33	4987 0		
OBS	0010	20 03	35 91	25 47		5 33	4987 0		
OBS	0019	20 02	35 91	25 47		5 19	4987 4		
STD	0020	20 02	35 91	25 47	0 051	5 20	4987 5		
OBS	0029	20 02	35 90	25 46		5 27	4988 0		
STD	0030	20 02	35 90	25 46	0 076	5 26	4988 0		
OBS	0048	20 00	35 92	25 48		5 20	4989 0		
STD	0050	19 92	35 91	25 49	0 126	5 22	4988 3		
OBS	0072	18 55	35 81	25 77		5 44	4976 5		
STD	0075	18 17	35 79	25 85	0 185	5 47	4973 0		
OBS	0097	15 93	35 67	26 30		5 63	4951 6		
STD	0100	15 80	35 66	26 32	0 234	5 61	4950 5		
OBS	0145	14 32	35 51	26 53		5 42	4937 1		
STD	0150	14 26	35 51	26 54	0 316	5 42	4936 8		
OBS	0193	13 58	35 44	26 63		5 43	4931 7		
STD	0200	13 41	35 41	26 64	0 391	5 44	4930 2		
OBS	0242	12 45	35 25	26 71		5 52	4921 4		
STD	0250	12 32	35 22	26 72	0 463	5 57	4920 3		
OBS	0290	11 52	35 07	26 75		5 69	4913 0		
STD	0300	11 19	35 01	26 77	0 532	5 66	4909 6		
OBS	0335	10 27	34 84	26 80		5 58	4900 2		
STD	0400	09 56	34 75	26 85	0 664	5 58	4895 2		
OBS	0400	09 56	34 75	26 85		5 58	4895 2		
OBS	0465	09 02	34 66	26 87		5 66	4892 1		
STD	0500	08 87	34 64	26 88	0 793	5 51	4892 3		
OBS	0535	08 58	34 62	26 91		5 36	4890 7		
STD	0600	07 38	34 54	27 02	0 914	4 99	4879 2		
OBS	0670	06 21				4 67			
STD	0800	04 38	34 38	27 28	1 117	4 32	4850 7		
OBS	0805	04 32	34 38	27 28		4 31	4850 2		
STD	1000	03 97	34 37	27 31	1 291	3 99	4856 9		
OBS	1010	05 74*	34 37	27 11*			4881 5*		
STD	1200	03 61	34 45	27 41	1 454	3 76	4864 1		
OBS	1350	03 33	34 52	27 49		3 65	4869 4		
STD	1500	03 02	34 62	27 60	1 660	3 64	4874 3		
OBS	1680	02 70	34 69	27 69		3 62	4880 8		
STD	2000	02 26	34 70	27 73	1 928	3 81	4893 5		
OBS	2015	02 24	34 70	27 73		3 82	4894 1		

Sta. No.

2

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	10°	11	20	19	2	0
II	28°	11	17	15	5	0

Consec. Sta. No. 3		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0003	04	02	1961	24	32	09 S	093	49 E	4114	28

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ▼	WET ▼			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
07	02		28	18	15	6		80	9	9	16	2		7	00	25

SUBSURFACE OBSERVATIONS							
	SAMPLE DEPTH (M)	T °C		S ‰		σ _t	
		↓	↓	↓	↓	↓	↓
STD	0000	19	79	35	77	25	42
ORBS	0000	19	79	35	77	25	42
STD	0010	19	78	35	79	25	44
ORBS	0010	19	78	35	79	25	44
STD	0020	19	80	35	77	25	42
ORBS	0020	19	80	35	77	25	42
ORBS	0029	19	78	35	76	25	42
STD	0030	19	77	35	77	25	43
ORBS	0049	19	55	35	81	25	52
STD	0050	19	26	35	79	25	58
ORBS	0074	14	40	35	41	26	44
STD	0075	14	35	35	41	26	45
ORBS	0098	13	43	35	37	26	61
STD	0100	13	38	35	36	26	61
ORBS	0147	12	56	35	25	26	69
STD	0150	12	55	35	25	26	69
ORBS	0197	12	28	35	22	26	72
STD	0200	12	26	35	22	26	73
ORBS	0246	11	88	35	17	26	76
STD	0250	11	84	35	16	26	76
ORBS	0295	11	44	35	08	26	78
STD	0300	11	41	35	07	26	77
ORBS	0373	10	98	34	99	26	79
STD	0400	10	79	34	96	26	80
ORBS	0467	10	35	34	89	26	82
STD	0500	10	17	34	86	26	83
ORBS	0561	09	79	34	81	26	86
STD	0600	09	51	34	77	26	87
ORBS	0654	09	06	34	71	26	90
ORBS	0748	08	09	34	60	26	97
STD	0800	07	26	34	53	27	03
ORBS	0936	05	47	34	43	27	19
STD	1000	04	82	34	46	27	29
ORBS	1124	03	93	34	50	27	42
STD	1200	03	90	34	52	27	44
ORBS	1408	03	80	34	57	27	49
STD	1500	03	50	34	60	27	54
ORBS	1882	02	56	34	69	27	70
STD	2000	02	43	34	72	27	73
ORBS	2361	02	08	34	78	27	81
STD	2500	01	96	34	77	27	81
ORBS	2847	01	69	34	76	27	83

Sta. No.
3

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	10°	11	20	20	2	2
II	5°	11	17	17	5	3

Consec. Sta. No. 4		SURFACE OBSERVATIONS									
ACCD REF. NO.	STATION	DATE				POSITION		SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH		
		MO.	DAY	YEAR	HOUR	LATITUDE	LONGITUDE				
00599	0004	04	04	1961	08	31° 59' S	085° 35' E	3795	27		

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		W/S	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL	TRANS
04	09		27	23	3	18	1		02	4	3	10	2		7	00 39

		SUBSURFACE OBSERVATIONS											
SAMPLE DEPTH (M)		T °C		S‰		σ _t		Σ ΔD		O ₂ ml/l		V _t	
		↓		↓		↓		↓		↓		↓	
STD	0000	21	31	35	69	24	95	0	000	4	48	4997	0
OBS	0000	21	31	35	69	24	95			4	48	4997	0
STD	0010	21	07	35	68	25	01	0	030	5	04	4995	5
OBS	0010	21	07	35	68	25	01			5	04	4995	
STD	0020	21	07	35	70	25	03	0	059	5	08	4996	1
OBS	0020	21	07	35	70	25	03			5	08	4996	1
STD	0030	21	07	35	73	25	05	0	089	5	03	4996	8
OBS	0030	21	07	35	73	25	05			5	03	4996	8
STD	0050	18	27	35	53	25	63	0	142	6	05	4971	5
OBS	0050	18	27	35	53	25	63			6	05	4971	5
STD	0075	15	34	35	47	26	28	0	194	6	16	4943	5
OBS	0075	15	34	35	47	26	28			6	16	4943	5
STD	0100	14	23	35	44	26	50	0	236	5	61	4933	2
OBS	0100	14	23	35	44	26	50			5	61	4933	2
STD	0150	13	12	35	33	26	64	0	311	5	33	4923	7
OBS	0150	13	12	35	33	26	64			5	33	4923	7
STD	0200	12	49	35	26	26	71	0	382	5	40	4919	4
OBS	0200	12	49	35	55*	26	94*			5	40	4920	5
STD	0250	12	13	35	19	26	73	0	452	5	39	4918	0
OBS	0250	12	13	35	19	26	73			5	39	4918	0
STD	0300	11	81	35	12	26	74	0	521	5	34	4917	1
OBS	0300	11	81	35	12	26	74			5	34	4917	1
OBS	0329	11	66	35	08	26	73			5	43	4917	0
STD	0400	11	32	35	03	26	76	0	660	5	40	4917	1
OBS	0414	11	23	35	02	26	77			5	40	4916	8
OBS	0498	10	60	34	93	26	81			5	45	4914	1
STD	0500	10	58	34	93	26	82	0	798	5	45	4914	0
OBS	0583	09	92	34	84	26	86			5	32	4910	7
STD	0600	09	80	34	82	26	87	0	931	5	30	4910	2
OBS	0670	09	22	34	74	26	90			5	17	4907	0
STD	0800	07	62	34	58	27	02	1	181	4	75	4894	2
OBS	0846	07	04	34	53	27	06			4	66	4889	4
STD	1000	04	94	34	41	27	24	1	395	4	59	4870	3
OBS	1025	04	69	34	40	27	26			4	55	4868	4
STD	1200	03	86	34	48	27	41	1	568	3	89	4867	7
OBS	1294	03	50	34	52	27	48			3	65	4868	4
STD	1500	03	10	34	60	27	58	1	779	3	68	4875	4
OBS	1761	02	67	34	68	27	68			3	71	4885	1
STD	2000	02	37	34	75	27	76	2	048	3	89	4895	3
OBS	2232	02	13	34	79	27	81			4	05	4905	7
STD	2500	01	90	34	79	27	83	2	257	4	23	4918	2
OBS	2719	01	76	34	75	27	81			4	37	4929	

Sta. No.

4

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	0°	11	20	15	2	1
II	31°	11	17	17	5	4

Consec. Sta. No. 5		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH ¹ UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0005	04	05	1961	15	32° 00' S	078° 00' E		3109	29	

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA	SWELL		VIS	WATER	
SPEED	DIR.			DRY ▼	WET ▼			TYPE	AMT.		DIR.	AMT.		COL.	TRANS.
04	07		30	23	9	21	1	02	0	0			7	00	

		SUBSURFACE OBSERVATIONS											
		SAMPLE DEPTH (M)	T °C		S% O	σ _t	Σ ΔD	O ₂ ml/l	V _t				
			↓	↓						↓	↓		
STD	0000	22	35	35	82	24	76	0	000	5	06	5006	5
	OBS 0000	22	35	35	82	24	76			5	06	5006	5
STD	0010	22	41	35	83	24	75	0	032	5	15	5007	7
	OBS 0010	22	41	35	83	24	75			5	15	5007	7
STD	0020	22	29	35	79	24	76	0	064	5	08	5007	1
	OBS 0020	22	29	35	79	24	76			5	08	5007	1
STD	0030	22	07	35	82	24	84	0	096	5	08	5005	9
	OBS 0030	22	07	35	82	24	84			5	08	5005	9
STD	0050	17	34	35	67	25	96	0	148	5	04	4963	0
	OBS 0050	17	34	35	67	25	96			5	04	4963	0
OBS	0074	15	57	35	52	26	26			5	63	4946	0
	STD 0075	15	50	35	51	26	27	0	196	5	62	4945	3
OBS	0099	14	22	35	39	26	46			5	51	4932	8
	STD 0100	14	20	35	39	26	46	0	238	5	51	4932	7
OBS	0149	13	41	35	36	26	61			5	56	4926	9
	STD 0150	13	40	35	36	26	61	0	315	5	56	4926	9
OBS	0199	12	82	35	25	26	64			5	45	4923	0
	STD 0200	12	81	35	25	26	64	0	389	5	45	4922	9
OBS	0248	12	44	35	17	26	65			5	38	4921	3
	STD 0250	12	42	35	17	26	66	0	462	5	38	4921	2
OBS	0298	12	11	35	14	26	70			5	41	4920	5
	STD 0300	12	10	35	14	26	70	0	534	5	41	4920	5
OBS	0385	11	81	35	08	26	71			5	47	4922	0
	STD 0400	11	75	35	07	26	71	0	677	5	47	4922	2
OBS	0482	11	29	35	01	26	75			5	47	4921	5
	STD 0500	11	16	34	99	26	76	0	820	5	44	4921	0
OBS	0579	10	50	34	88	26	79			5	42	4917	5
	STD 0600	10	31	34	86	26	81	0	960	5	53	4916	4
OBS	0677	09	52	34	76	26	87			5	63	4911	2
	OBS 0774	08	28	34	58	26	92			5	02	4901	0
STD	0800	08	00	34	55	26	94	1	224	4	98	4898	9
	OBS 0970	06	12	34	40	27	08			4	73	4884	2
STD	1000	05	70	34	38	27	12	1	458	4	69	4880	4
	OBS 1166	03	89	34	34	27	29			4	49	4865	5
STD	1200	03	75	34	36	27	32	1	651	4	43	4865	7
	OBS 1461	02	92	34	51	27	52			4	09	4870	1
STD	1500	02	87	34	53	27	54	1	876	4	10	4871	8
	OBS 1952	02	35	34	69	27	72			4	17	4891	9
STD	2000	02	28	34	71	27	74	2	156	4	21	4893	8
	OBS 2445	01	83	34	79	27	84			4	46	4914	0
STD	2500	01	79	34	79	27	84	2	365	4	48	4916	6
	OBS 2940	01	66	34	76	27	83			4	48	4940	6

Sta. No.
5

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	7°	11	20	17	2	1
II	2°	11	17	15	5	4

Consec. Sta. No. 6		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0006	04	06	1961	02	30 °	00' S	078 °	00' E	3566	10

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
07	08		28	23	3	19	4		02	8	5	07	2		7	00 30

		SUBSURFACE OBSERVATIONS									
		SAMPLE DEPTH (M)	T °C		S ‰		σ _t		Σ ΔD	O ₂ ml/l	V _t
			↓	↓	↓	↓	↓	↓	↓	↓	
STD	0000	23	64	36	04	24	55	0 000	5 47	5018 1	
OBS	0000	23	64	36	04	24	55		5 47	5018 1	
STD	0010	23	63	36	08	24	59	0 034	4 88	5018 8	
OBS	0010	23	63	36	08	24	59		4 88	5018 8	
STD	0020	23	64	36	13	24	62	0 067	4 86	5019 6	
OBS	0020	23	64	36	13	24	62		4 86	5019 6	
STD	0030	23	62	36	06	24	58	0 101	4 90	5019 8	
OBS	0030	23	62	36	06	24	58		4 90	5019 8	
OBS	0049	19	50	35	79	25	51		5 75	4984 0	
STD	0050	19	42	35	79	25	53	0 159	5 77	4983 3	
OBS	0074	17	59	35	68	25	91		6 04	4966 9	
STD	0075	17	52	35	68	25	93	0 217	6 03	4966 3	
OBS	0099	16	03	35	57	26	20		5 72	4952 4	
STD	0100	15	98	35	56	26	20	0 266	5 71	4951 9	
OBS	0149	14	19	35	25	26	36		5 40	4934 9	
STD	0150	14	16	35	25	26	36	0 356	5 40	4934 7	
OBS	0198	13	23	35	23	26	54		5 41	4927 4	
STD	0200	13	22	35	23	26	54	0 437	5 30	4927 4	
OBS	0248	12	84	35	16	26	57		3 96	4925 8	
STD	0250	12	82	35	16	26	57	0 515	4 04	4925 6	
OBS	0298	12	35						5 41		
STD	0300	12	34	35	16	26	67	0 590	5 41	4923 3	
OBS	0391	11	97	35	12	26	71		5 42	4924 3	
STD	0400	11	91	35	11	26	71	0 735	5 42	4924 1	
OBS	0489	11	32	35	04	26	77		5 35	4922 4	
STD	0500	11	24	35	03	26	77	0 877	5 30	4922 1	
OBS	0587	10	59	34	95	26	83		5 10	4919 3	
STD	0600	10	50	34	93	26	83	1 015	5 17	4919 0	
OBS	0685	09	81	34	82	26	86		5 37	4915 4	
OBS	0782	08	78	34	69	26	93		5 12	4908 1	
STD	0800	08	56	34	67	26	95	1 277	5 07	4906 4	
OBS	0978	05	88	34	47	27	17		4 63	4881 8	

Sta. No.
6

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	10°	11	20	19	2	1
II	7°	6	9	8	3	1

SURFACE OBSERVATIONS										
Consec. Sta. No. 7										
NODC REF. NO.	STATION	DATE				POSITION			SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE		
00599	0007	04	06	1961	13	27° 58' S		078° 03' E	4755	09

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
11	09		25	23.9	21.0			01	8	3	04	4		7	00	

		SUBSURFACE OBSERVATIONS							
		SAMPLE DEPTH (M)	T °C ↓	S‰ O ↓	σ _t ↓	Σ ΔD ↓	O ₂ m/l ↓	V _t ↓	
STD	0000	24	88	35 82	24 02	0 000		5027 4	
OBS	0000	24	88	35 82	24 02			5027 4	
OBS	0008	24	94	35 82	24 00			5028 3	
STD	0010	24	93	35 82	24 00	0 039		5028 4	
OBS	0017	24	92	35 81	24 00			5028 7	
STD	0020	24	92	35 81	24 00	0 078		5028 9	
OBS	0026	24	92	35 80	23 99			5029 2	
STD	0030	23	96	35 79	24 27	0 116		5021 7	
OBS	0043	21	45	35 76	24 97			5001 1	
STD	0050	20	71	35 75	25 16	0 181		4994 9	
OBS	0064	19	42	35 73	25 49			4983 9	
STD	0075	18	64	35 73	25 69	0 246		4977 2	
OBS	0086	17	92	35 73	25 87			4971 0	
STD	0100	17	09	35 69	26 04	0 300		4963 5	
OBS	0129	15	73	35 60	26 29			4951 2	
STD	0150	15	18	35 54	26 37	0 393		4946 6	
OBS	0173	14	58	35 48	26 45			4941 4	
STD	0200	13	85	35 40	26 55	0 475		4934 9	
OBS	0217	13	46	35 35	26 59			4931 5	
STD	0250	13	12	35 27	26 60	0 552		4929 4	
OBS	0262	13	56*	35 25	26 49*			4934 8*	
STD	0300	12	64	35 23	26 66	0 627		4926 9	
OBS	0332	12	35	35 20	26 70			4925 4	
STD	0400	11	77	35 12	26 74	0 770		4922 6	
OBS	0416	11	65	35 10	26 75			4922 1	
STD	0500	11	10	35 01	26 78	0 910		4920 4	
OBS	0503	11	08	35 01	26 79			4920 3	
OBS	0591	10	30	34 90	26 84			4915 9	
STD	0600	10	22	34 89	26 85	1 047		4915 5	
OBS	0682	09	43	34 78	26 90			4910 4	
STD	0800	07	97	34 63	27 01	1 301		4898 9	
OBS	0873	06	89	34 53	27 08			4889 0	

Sta. No.

7

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	25°	11	20	17	2	1
II	37°	6	8	8	4	1

Consec. Sta. No. 8		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0008	04	06	1961	24	25° 54' S		078° 04' E		4207	26

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIP	AMT	DIR	AMT		COL.	TRANS
09	08		23	24.2	20.0		02	8	2	08	3			7	00	22

		SUBSURFACE OBSERVATIONS									
		SAMPLE DEPTH (M)	T °C		S‰ O		σ _t		Σ ΔD	O ₂ m/l	V _t
STD		0000	25	30	35	64	23	75	0 000	4 81	5030 1
OBS		0000	25	30	35	64	23	75		4 81	5030 1
OBS		0009	25	29	35	64	23	76		4 72	5030 5
STD		0010	25	29	35	68	23	79	0 041	4 71	5030 7
OBS		0019	25	29	35	86	23	92		4 68	5031 9
STD		0020	25	29	35	85	23	92	0 082	4 69	5031 9
OBS		0028	25	25	35	78	23	87		4 76	5031 9
STD		0030	25	19	35	77	23	89	0 122	4 77	5031 5
OBS		0047	24	69	35	71	23	99		4 92	5028 3
STD		0050	24	24	35	69	24	11	0 201	5 02	5024 8
OBS		0070	21	84	35	64	24	77		5 44	5005 6
STD		0075	21	50	35	65	24	87	0 288	5 42	5003 0
OBS		0093	20	41	35	68	25	19		5 36	4994 5
STD		0100	20	13	35	70	25	28	0 361	5 32	4992 4
OBS		0140	18	64	35	77	25	72		5 12	4981 2
STD		0150	18	36	35	77	25	79	0 486	5 08	4979 2
OBS		0188	17	11	35	75	26	08		4 99	4969 2
STD		0200	16	55	35	68	26	16	0 591	5 00	4964 1
OBS		0235	15	14	35	52	26	36		5 03	4951 1
STD		0250	14	66	35	47	26	43	0 681	5 08	4946 8
OBS		0282	13	81	35	37	26	53		5 18	4939 2
STD		0300	13	53	35	34	26	57	0 763	5 23	4937 1
OBS		0340	12	91	35	27	26	64		5 32	4932 4
STD		0400	11	85	35	17	26	77	0 910	5 35	4923 7
OBS		0423	11	59	35	14	26	79		5 36	4922 0
STD		0500	11	39	35	05	26	76	1 050	5 38	4923 9
OBS		0509	11	34	35	04	26	76		5 38	4923 8
OBS		0595	10	61	34	95	26	83		5 46	4920 0
STD		0600	10	57	34	95	26	83	1 189	5 46	4919 9
OBS		0681	09	79	34	86	26	90		5 44	4915 0
STD		0800	08	48	34	67	26	96	1 450	5 19	4905 4
OBS		0851	07	81	34	60	27	01		4 99	4899 7
STD		1000	05	39	34	45	27	22	1 673	4 04	4876 6
OBS		1022	05	12	34	44	27	24		3 94	4874 2
STD		1200	04	02	34	52	27	42	1 848	3 57	4870 1
OBS		1282	03	66	34	55	27	48		3 45	4870 1
STD		1500	03	58	34	63	27	56	2 063	3 44	4882 2
OBS		1718	03	32	34	70	27	64		3 42	4891 8
STD		2000	02	54	34	77	27	76	2 343	3 80	4897 8
OBS		2168	02	21	34	80	27	82		3 99	4903 1
STD		2500	01	83	34	80	27	85	2 550	4 28	4917 3
OBS		2631	01	79	34	80	27	85		4 37	4924 4

Sta. No.

8

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	16°	11	20	18	2	0
II	28°	11	17	13	5	2

Consec. Sta. No. 9		SURFACE OBSERVATIONS										SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
NODC REF. NO.	STATION	DATE				POSITION							
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE					
00599	0009	04	07	1961	11	24 ° 00' S		078 ° 05' E		4023	09		

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
10	09		18	24.8	21.2			03	8	6	09	4		7	00	25

SUBSURFACE OBSERVATIONS							
	SAMPLE DEPTH (M)	T °C ↓	S% O ↓	σ_t ↓	$\Sigma \Delta D$ ↓	O ₂ ml/l ↓	V _t ↓
STD	0000	25 05				4 43	
OBS	0000	25 05	36 00*	24 10*		4 43	5029 4*
OBS	0009	25 03	35 82	23 97		4 80	5029 1
STD	0010	25 03	35 82	23 97		4 80	5029 2
OBS	0018	25 03	35 82	23 97		4 80	5029 7
STD	0020	25 03	35 83	23 98		4 80	5029 8
OBS	0027	25 01	35 86	24 01		4 81	5030 2
STD	0030	24 72	35 86	24 10		4 82	5028 1
OBS	0045		35 84			4 85	
STD	0050	22 90	35 80	24 59		5 02	5014 1
OBS	0068	21 42	35 73	24 95		5 43	5002 2
STD	0075	20 83	35 75	25 13		5 43	4997 4
OBS	0092	19 68	35 78	25 46		5 44	4988 1
STD	0100	19 56	35 79	25 50		5 44	4987 5
OBS	0140	18 55	35 81	25 77		5 40	4980 5
STD	0150	18 10	35 80	25 88		5 37	4976 8
OBS	0188	16 47	35 74	26 22		5 27	4962 8
STD	0200	15 90	35 67	26 30		5 24	4957 4
OBS	0238	14 46	35 74*	26 68*		5 21	4945 0*
STD	0250	14 16	35 45	26 52		5 24	4941 4
OBS	0287	13 37	35 33	26 59		5 29	4934 6
STD	0300	13 17	35 31	26 62		5 29	4933 1
OBS	0340	12 60	35 24	26 68		5 31	4928 8
STD	0400	11 85	35 14	26 75		5 40	4923 6
OBS	0426	11 55	35 10	26 77		5 42	4921 5
STD	0500	10 75	35 00	26 84		5 45	4916 2
OBS	0513	10 61	34 98	26 85		5 45	4915 3
STD	0600	09 73	34 82	26 88		5 46	4909 4
OBS	0603	09 70	34 81	26 87		5 46	4909 1
OBS	0694	08 86	34 75	26 96		5 36	4904 1
STD	0800	07 47	34 62	27 07		5 09	4892 5
OBS	0884	06 06	34 48	27 16		4 77	4878 7

Sta. No.
9

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	25°	11	17	14	3	1
II	32°	6	8	8	4	2

Consec. Sta. No. 10		SURFACE OBSERVATIONS									
NODC REF NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0010	04	07	1961	21	21° 58' S		077° 58' E		4389	08

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR	AMT.	DIR	AMT.		COL.	TRANS
10	09		18	25 3	21 1		25	5	8	08	3			7	00	

SUBSURFACE OBSERVATIONS									
SAMPLE DEPTH (M)		T °C ↓	S ‰ ↓	σ _t ↓	Σ ΔD ↓	O ₂ ml/l ↓	V _t ↓		
STD	0000	26 13 35	09	23 08	0 000		5034 6		
OBS	0000	26 13 35	09	23 08			5034 6		
STD	0010	26 14 35	08	23 07	0 048		5035 3		
OBS	0010	26 14 35	08	23 07			5035 3		
OBS	0019	26 13 35	09	23 08			5035 8		
STD	0020	26 13 35	09	23 08	0 096		5035 8		
OBS	0029	26 15 35	10	23 08			5036 5		
STD	0030	26 15 35	10	23 08	0 144		5036 6		
OBS	0048	26 11 35	15	23 13			5037 6		
STD	0050	26 10 35	25	23 21	0 239		5037 9		
OBS	0072	25 24 35	91	23 98			5034 9		
STD	0075	24 89 35	86	24 04	0 347		5032 1		
OBS	0096	22 76 35	61	24 48			5015 0		
STD	0100	22 47 35	63	24 58	0 438		5012 8		
OBS	0143	20 04 35	75	25 34			4994 4		
STD	0150	19 88 35	76	25 39	0 589		4993 3		
OBS	0192	18 71 35	79	25 72			4985 0		
STD	0200	18 42 35	79	25 79	0 713		4982 8		
OBS	0240	16 94 35	74	26 11			4970 5		
STD	0250	16 47 35	70	26 19	0 817		4966 3		
OBS	0289	15 01 35	58	26 43			4953 2		
STD	0300	14 79 35	56	26 47	0 907		4951 4		
OBS	0340	13 97 35	46	26 57			4944 7		
STD	0400	12 63 35	30	26 72	1 062		4933 0		
OBS	0420	12 27 35	25	26 75			4929 9		
STD	0500	11 23 35	09	26 82	1 202		4922 2		
OBS	0500	11 23 35	09	26 82			4922 2		
OBS	0590	10 25 34	95	26 89			4915 5		
OBS	0680	19 96*35	69*	25 32*			5025 2*		
OBS	0850	15 00*35	80*	26 61*			4987 0*		

Sta. No.
10

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	15°	11	20	20	2	1
II	32°	6	8	7	1	1

Consec. Sta. No. 11		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0011	04	08	1961	08	20° 00' S		078° 02' E		4755	29

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
11	09		15	26	9	22	2	02	8	1	09	3		7		25

		SUBSURFACE OBSERVATIONS									
SAMPLE DEPTH (M)		T °C ↓	S‰ O ↓		σ _t ↓		Σ ΔD ↓	O ₂ ml/l ↓	V _t ↓		
STD	0000	27 56	34 20	21 96	0 000	4 45	5042 3				
OBS	0000	27 56	34 20	21 96		4 45	5042 3				
STD	0010	27 54	34 20	21 96	0 059	4 48	5042 8				
OBS	0010	27 54	34 20	21 96		4 48	5042 8				
STD	0020	27 53	34 21	21 98	0 117	4 44	5043 3				
OBS	0020	27 53	34 21	21 98		4 44	5043 3				
STD	0030	27 55	34 20	21 96	0 176	4 51	5044 1				
OBS	0030	27 55	34 20	21 96		4 51	5044 1				
STD	0050	27 52	34 20	21 97	0 294	4 48	5045 0				
OBS	0050	27 52	34 20	21 97		4 48	5045 0				
STD	0075	23 72	34 17	23 12	0 427	4 68	5016 6				
OBS	0075	23 72	34 17	23 12		4 68	5016 6				
OBS	0099	22 81	35 30	24 24		5 09	5014 5				
STD	0100	22 77	35 31	24 25	0 533	5 08	5014 2				
OBS	0149	20 92	35 54	24 95		4 69	5001 9				
STD	0150	20 88	35 54	24 96	0 703	4 68	5001 6				
OBS	0199	19 30	35 65	25 46		4 37	4990 5				
STD	0200	19 29	35 65	25 46	0 844	4 38	4990 5				
OBS	0249	18 14	35 77	25 84		4 60	4982 9				
STD	0250	18 09	35 77	25 86	0 965	4 60	4982 5				
OBS	0299	16 08	35 70	26 28		4 75	4965 2				
STD	0300	16 05	35 70	26 29	1 067	4 75	4965 0				
OBS	0380	13 65	35 43	26 61		5 03	4943 5				
STD	0400	13 13	35 37	26 67	1 233	5 13	4938 8				
OBS	0477	11 40	35 15	26 84		5 37	4923 0				
STD	0500	11 01	35 08	26 85	1 373	5 37	4919 6				
OBS	0572	09 89	34 88	26 90		5 34	4909 9				
STD	0600	09 57	34 83	26 91	1 503	5 31	4907 5				
OBS	0667	08 67	34 71	26 96		5 25	4900 0				
OBS	0763	07 06	34 57	27 09		4 54	4884 9				
STD	0800	06 51	34 57	27 17	1 733	4 81	4880 0				
OBS	0955	04 83	35 28*	27 94*		4 92	4869 9*				
STD	1000	04 65	34 59	27 41	1 914	4 26	4867 2				
OBS	1150	04 11	34 62	27 49		2 76	4868 8				
STD	1200	04 00	34 64	27 52	2 060	2 76	4870 3				
OBS	1435	04 52*	34 71	27 52*		2 78	4891 7*				
STD	1500	03 38	34 72	27 65	2 248	2 84	4879 8				
OBS	1920	02 65	34 75	27 74		3 27	4894 5				
STD	2000	02 53	34 75	27 75	2 508	3 38	4897 6				
OBS	2404	02 02	34 76	27 80		3 81	4914 2				
STD	2500	01 93	34 76	27 81	2 729	3 88	4918 5				
OBS	2892	01 68	34 76	27 83		4 08	4938 1				

Sta. No.
11

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	12°	11	20	19	2	1
II	22°	11	17	14	5	1

Consec. Sta. No. 12		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0012	04	08	1961	19	18	00 S	078	02 E	4572	09

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR	AMT	DIR	AMT		COL	TRANS.
10	06		14	26.4	22.8			02	8	2	07	3		7	00	

SUBSURFACE OBSERVATIONS							
	SAMPLE DEPTH (M)	T °C		S‰ O	σ _t ↓	Σ ΔD	O ₂ m/l
		↓	↓				↓
STD	0000	27	25				5 01
OBS	0000	27	25	34	76*	22 48*	5 01
OBS	0009	27	26	34	20	22 05	4 55
STD	0010	27	26	34	20	22 05	4 54
OBS	0019	27	27	34	19	22 04	4 53
STD	0020	27	27	34	19	22 04	4 54
OBS	0028	27	28	34	20	22 05	4 58
STD	0030	27	28	34	20	22 05	4 56
OBS	0047	27	25	34	23	22 08	4 47
STD	0050	27	25	34	23	22 08	4 53
OBS	0070	27	25	34	22	22 07	4 57
STD	0075	25	99	34	44	22 64	4 40
OBS	0093	22	29	35	06	24 20	3 87
STD	0100	21	65	35	10	24 41	3 73
OBS	0140	18	75	35	26	25 30	3 25
STD	0150	18	36	35	28	25 42	3 27
OBS	0188	17	02	35	32	25 77	3 37
STD	0200	16	61	35	32	25 87	3 38
OBS	0235	15	62	35	32	26 10	3 60
STD	0250	15	48	35	43	26 21	3 96
OBS	0285	14	76	35	49	26 42	4 45
STD	0300	14	18	35	40	26 48	4 44
OBS	0322	13	42	35	28	26 54	4 42
STD	0400	11	69	35	11	26 75	5 14
OBS	0416	11	38	35	07	26 78	5 23
STD	0500	09	95	34	86	26 87	5 34
OBS	0502	09	92	34	85	26 87	5 34
OBS	0590	08	65	34	69	26 95	5 05
STD	0600	08	43	34	67	26 97	4 92
OBS	0677	07	02	34	57	27 10	3 95
STD	0800	05	76	34	59	27 28	2 65
OBS	0852	05	59	34	66	27 36	2 19

Sta. No. 12	Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
				Protected		Unprotected	
				Used	Accepted	Used	Accepted
	I	22°	11	20	18	2	2
	II	35°	6	8	8	4	4

Consec. Sta. No. 13		SURFACE OBSERVATIONS											
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH		
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE					
00599	0013	04	09	1961	06	16	03	S	078	03	E	4938	10

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
10	08		14	27 3	23 7			02	8 3	09	3			7	00	25

		SUBSURFACE OBSERVATIONS										
		SAMPLE DEPTH (M)	T °C		S‰		σ _t		Σ ΔD		O ₂ m l/l	V _t
			↓		↓		↓		↓			
STD	0000	27	47	34	29	22	05	0	000		5042	0
OBS	0000	27	47	34	29	22	05				5042	0
STD	0010	27	46	34	25	22	03	0	058		5042	4
OBS	0010	27	46	34	25	22	03				5042	4
OBS	0019	27	47	34	23	22	01				5042	9
STD	0020	27	47	34	23	22	01	0	116		5043	0
OBS	0029	27	48	34	23	22	01				5043	6
STD	0030	27	48	34	23	22	01	0	174		5043	6
OBS	0048	27	41	34	23	22	03				5044	2
STD	0050	27	36	34	28	22	08	0	291		5044	1
OBS	0072		26	86								
STD	0075	26	18	34	77	22	83	0	426		5038	4
OBS	0097	22	18	35	08	24	25				5008	2
STD	0100	21	96	35	10	24	32	0	535		5006	5
OBS	0145	19	36	35	37	25	23				4986	8
STD	0150	19	36	35	45	25	29	0	695		4987	4
OBS	0193	18	08	35	70	25	81				4978	8
STD	0200	17	29	35	57	25	90	0	818		4971	0
OBS	0241	13	92	35	08	26	28				4936	8
STD	0250	13	65	35	07	26	33	0	916		4934	4
OBS	0290	12	65	35	03	26	50				4925	6
STD	0300	12	58	35	04	26	53	1	000		4925	5
OBS	0392	11	39	35	08	26	78				4917	6
STD	0400	11	14	35	07	26	82	1	147		4915	1
OBS	0490	09	04	34	92	27	07				4894	9
STD	0500	08	96	34	89	27	06	1	269		4894	4
OBS	0588	08	16	34	69	27	03				4888	9
STD	0600	08	01	34	68	27	04	1	381		4887	7
OBS	0686	07	14	34	67	27	16				4881	7
OBS	0785	06	51	34	72	27	29				4879	7
STD	0800	06	43	34	73	27	30	1	584		4879	6
OBS	0982	05	86	34	78	27	42				4883	1

Sta. No.

13

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	15°	11	20	17	2	0
II	12°	6	8	7	4	1

Consec. Sta. No. 14		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0014	04	09	1961	17	14	00 S	078	03 E	5303	28

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR	AMT.		COL.	TRANS.
08	11		13	27.2	24.4			80	8	1	10	2		6		

SUBSURFACE OBSERVATIONS									
	SAMPLE DEPTH (M)	T °C		S % O	σ _t	Σ Δ D	O ₂ ml/l	V _t	
		↓	↓	↓	↓	↓	↓	↓	↓
STD	0000	27	35	34	38	22	16	0	000
OBS	0000	27	35	34	38	22	16	4	54
STD	0010	27	36	34	42	22	19	0	057
OBS	0010	27	36	34	42	22	19	4	53
STD	0020	27	36	34	40	22	17	0	113
OBS	0020	27	36	34	40	22	17	4	52
STD	0030	27	36	34	40	22	17	0	170
OBS	0030	27	36	34	40	22	17	4	48
OBS	0049	27	33	34	42	22	20	4	56
STD	0050	27	29	34	43	22	22	0	283
OBS	0074	25	92	34	61	22	79	4	71
STD	0075	25	81	34	63	22	83	0	417
OBS	0099	23	49	35	01	23	82	3	18
STD	0100	23	41	35	01	23	84	0	532
OBS	0148	20	05	35	03	24	79	3	15
STD	0150	19	95	35	03	24	82	0	714
OBS	0198	17	58	35	06	25	44	2	70
STD	0200	17	48	35	09	25	49	0	858
OBS	0247	15	32	35	31	26	16	3	67
STD	0250	15	17	35	26	26	15	0	971
OBS	0297			34	77			4	03
STD	0300	12	94	34	78	26	25	1	066
OBS	0370	10	78	34	85	26	72	2	89
STD	0400	10	40	34	83	26	77	1	228
OBS	0462	09	63	34	80	26	88	3	64
STD	0500	09	11	34	77	26	94	1	357
OBS	0555	08	50	34	74	27	01	2	84
STD	0600	08	11	34	71	27	05	1	475
OBS	0648	07	84	34	69	27	07	2	24
OBS	0740	07	76	34	69	27	09	1	97
STD	0800	07	42	34	70	27	14	1	694
OBS	0927	06	63	34	71	27	26	1	96
STD	1000	06	04	34	70	27	33	1	889
OBS	1114	05	29	34	69	27	42	1	98
STD	1200	05	01	34	70	27	46	2	054
OBS	1395	04	37	34	71	27	54	2	25
STD	1500	03	98	34	75	27	61	2	264
OBS	1866	02	90	34	82	27	77	3	10
STD	2000	02	66	34	79	27	77	2	535
OBS	2350	02	18	34	73	27	76	3	60
STD	2500	02	03	34	72	27	77	2	763
OBS	2846	01	83	34	72	27	78	3	92

Sta. No.
14

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	9°	11	20	16	2	0
II	25°	11	17	12	5	3

Consec. Sta. No. 15		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0015	04	10	1961	04	11 °	58' S	077 °	48' E	5304	06

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
10	09		12	28	3	25	6		80	8	7	08	2		7	00 24

		SUBSURFACE OBSERVATIONS												
		SAMPLE DEPTH (M)	T °C ↓		S ‰ ↓		σ _t ↓		Σ ΔD ↓		O ₂ ml/l ↓		V _t ↓	
STD	0000	27	71	34	21	21	92	0	000	4	52	5043	5	
OBS	0000	27	71	34	21	21	92			4	52	5043	5	
OBS	0008	27	70	34	21	21	92			4	50	5043	9	
STD	0010	27	70	34	21	21	92	0	059	4	49	5044	0	
OBS	0017	27	69	34	21	21	92			4	47	5044	3	
STD	0020	27	69	34	21	21	92	0	118	4	48	5044	5	
OBS	0025	27	70	34	21	21	92			4	51	5044	9	
STD	0030	27	31	34	33	22	14	0	176	4	54	5042	7	
OBS	0042	26	24	34	54	22	63			4	60	5036	1	
STD	0050	25	27	34	60	22	98	0	283	4	13	5029	2	
OBS	0063	23	94	34	68	23	44			3	63	5019	5	
STD	0075	23	06	34	70	23	71	0	397	3	62	5013	0	
OBS	0084	22	41	34	73	23	92			3	52	5008	1	
STD	0100	21	31	34	90	24	35	0	495	2	76	5000	1	
OBS	0126	19	44	35	02	24	94			2	05	4985	1	
STD	0150	17	48	34	85	25	30	0	654	2	19	4967	2	
OBS	0169	16	11	34	77	25	56			2	28	4954	3	
STD	0200	14	07	34	79	26	03	0	773	2	37	4934	9	
OBS	0215	13	43	34	80	26	17			2	42	4928	9	
OBS	0236	12	90	34	88	26	34			2	32	4924	6	
STD	0250	12	55	34	87	26	40	0	866	2	46	4921	5	
OBS	0259	12	33	34	86	26	44			2	50	4919	6	
STD	0300	11	40	34	86	26	61	0	947	2	12	4911	4	
OBS	0300	11	40	34	86	26	61			2	12	4911	4	
OBS	0365	10	08	34	80	26	80			2	89	4899	6	
STD	0400	09	50	34	76	26	87	1	086	3	40	4894	5	
OBS	0432	09	03	34	73	26	92			3	53	4890	6	
STD	0500	08	21	34	67	27	00	1	207	2	69	4884	3	
OBS	0506	08	16	34	67	27	01			2	63	4884	0	
STD	0600	07	82	34	68	27	07	1	320	2	10	4885	3	
OBS	0627	07	72	34	70	27	10			2	07	4885	7	

Sta. No.
15

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	30°	11	20	19	2	1
II	50°	6	8	7	4	2

Consec. Sta. No. 16		SURFACE OBSERVATIONS											
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX SAMPLE DEPTH		
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE					
00599	0016	04	10	1961	15	10	00	S	077	56	E	5303	08

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS	WATER	
SPEED	DIR.			DRY ▼	WET ▼			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
11	06		12	27	1	24	8		80	6	8	10	3			00

		SUBSURFACE OBSERVATIONS									
		SAMPLE DEPTH (M)	T °C		S‰ O		σ _t		Σ ΔD	O ₂ ml/l	V _f
			↓	↓	↓	↓	↓	↓	↓	↓	↓
STD	0000	27	66	34	27	21	98	0	000		5043 3
OBS	0000	27	66	34	27	21	98				5043 3
OBS	0009	27	65	34	27	21	98				5043 8
STD	0010	27	65	34	27	21	98	0	059		5043 8
OBS	0018	27	65	34	28	21	99				5044 4
STD	0020	27	65	34	28	21	99	0	117		5044 5
OBS	0027	27	64	34	28	21	99				5044 8
STD	0030	27	34	34	40	22	18	0	175		5043 2
OBS	0046	25	49	34	84	23	09				5031 5
STD	0050	24	91	34	85	23	28	0	278		5027 2
OBS	0069	22	18	34	87	24	09				5005 8
STD	0075	21	26	34	86	24	34	0	381		4998 0
OBS	0092	19	00	34	84	24	92				4978 4
STD	0100	18	24	34	82	25	09	0	463		4971 5
OBS	0138	15	50	34	80	25	73				4946 4
STD	0150	15	18	34	89	25	87	0	590		4944 1
OBS	0184	14	06	35	01	26	20				4934 7
STD	0200	13	24	34	95	26	32	0	689		4926 5
OBS	0230	12	01	34	87	26	51				4914 3
STD	0250	11	40	34	85	26	60	0	770		4908 4
OBS	0276	10	90	34	84	26	69				4904 1
STD	0300	10	79	34	86	26	72	0	843		4904 3
OBS	0305	10	75	34	87	26	74				4904 2
OBS	0386	09	31	34	75	26	89				4891 4
STD	0400	09	14	34	74	26	91	0	974		4890 1
OBS	0470	08	34	34	71	27	01				4884 3
STD	0500	08	02	34	70	27	06	1	091		4882 0
OBS	0554	07	51	34	68	27	12				4878 7
STD	0600	07	14	34	66	27	15	1	197		4876 6
OBS	0646	06	79	34	65	27	19				4874 8
STD	0800	05	76	34	66	27	34	1	384		4870 5
OBS	0836	05	55	34	66	27	36				4869 8

Sta. No.

16

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	20°	11	20	19	2	1
II	40°	6	8	8	4	3

Consec. Sta. No. 17		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0017	04	11	1961	02	07° 53' S	078° 12' E		5303	28	

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
08	04		08	27 2	24 4			02	8	7	10	3		7	00	22

SUBSURFACE OBSERVATIONS							
	SAMPLE DEPTH (M)	T °C ↓	S % O ↓	σ _t ↓	Σ Δ D ↓	O ₂ ml/l ↓	V _t ↓
STD	0000	28 50	34 38	21 79	0 000	4 48	5049 8
OBS	0000	28 50	34 38	21 79		4 48	5049 8
OBS	0009	28 48	34 40	21 81		4 45	5050 3
STD	0010	28 47	34 40	21 81	0 060	4 46	5050 3
OBS	0018	28 41	34 40	21 83		4 51	5050 3
STD	0020	28 40	34 40	21 83	0 120	4 51	5050 4
OBS	0027	28 37	34 40	21 84		4 48	5050 6
STD	0030	27 50	34 57	22 26	0 178	4 45	5045 0
OBS	0046	23 67	35 18	23 90		4 28	5018 1
STD	0050	23 07	35 20	24 09	0 273	3 92	5013 4
OBS	0069	20 56	35 24	24 81		2 64	4992 8
STD	0075	19 87	35 23	24 99	0 359	2 46	4986 9
OBS	0092	18 23	35 20	25 39		2 06	4972 4
STD	0100	17 92	35 20	25 46	0 428	2 06	4969 8
OBS	0138	16 26	35 16	25 83		1 94	4955 5
STD	0150	15 57	35 09	25 93	0 545	1 77	4948 9
OBS	0184	13 87	34 96	26 20		1 47	4932 5
STD	0200	13 16	34 93	26 32	0 642	1 47	4925 6
OBS	0230	12 13	34 90	26 51		1 48	4915 7
STD	0250	11 74	34 91	26 59	0 724	1 49	4912 5
OBS	0276	11 29	34 92	26 68		1 51	4908 9
STD	0300	11 00	34 92	26 73	0 797	1 86	4907 0
OBS	0372	10 17	34 90	26 86		2 49	4901 4
STD	0400	09 84	34 88	26 91	0 929	2 48	4899 1
OBS	0465	09 20	34 85	26 99		2 35	4895 1
STD	0500	09 00	34 84	27 01	1 049	2 18	4894 7
OBS	0557	08 59	34 82	27 06		1 95	4893 0
STD	0600	08 11	34 81	27 13	1 159	1 81	4889 5
OBS	0650	07 66	34 80	27 19		1 69	4886 8
OBS	0744	07 15	34 81	27 27		1 60	4885 9
STD	0800	06 85	34 80	27 30	1 355	1 61	4885 3
OBS	0930	06 14	34 78	27 38		1 63	4883 7
STD	1000	05 69	34 76	27 42	1 524	1 75	4881 8
OBS	1117	05 04	34 74	27 49		1 93	4880 0
STD	1200	04 73	34 75	27 53	1 674	2 00	4880 8
OBS	1397	04 06	34 76	27 61		2 19	4883 3
STD	1500	03 80	34 76	27 64	1 867	2 34	4885 8
OBS	1967	02 76	34 77	27 75		2 98	4899 0
STD	2000	02 69	34 77	27 75	2 135	3 03	4899 9
OBS	2340	02 09	34 76	27 79		3 43	4911 4
STD	2500		34 75			3 57	
OBS	2818	02 83*	34 74	27 71*		3 75	4950 0*

Sta. No.

17

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	17°	11	20	20	2	1
II	15°	11	17	17	5	2

Consec. Sta. No. 18		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0018	04	11	1961	14	05° 58' S		078° 09' E		5121	10

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
02	14		08	28.9	25.0			02	8	4	00	1		7	00	

		SUBSURFACE OBSERVATIONS											
		SAMPLE DEPTH (M)	T °C		S‰ O		σ _t		Σ Δρ	O ₂ m/l	V _t		
			↓		↓		↓						
STD	0000	29	38	34	80	21	81	0	000	4	08	5057	5
OBS	0000	29	38	34	80	21	81			4	08	5057	5
STD	0010	29	15	34	78	21	87	0	060	4	33	5056	4
OBS	0010	29	15	34	78	21	87			4	33	5056	4
STD	0020	29	05	34	79	21	91	0	119	4	05	5056	3
OBS	0020	29	05	34	79	21	91			4	05	5056	3
STD	0030	29	50	35	13	22	01	0	178	4	68	5061	3
OBS	0030	29	50	35	13	22	01			4	68	5061	3
STD	0050	22	12	35	32	24	45	0	271	3	70	5005	7
OBS	0050	22	12	35	32	24	45			3	70	5005	7
STD	0075	19	30	35	23	25	14	0	351	2	73	4981	6
OBS	0075	19	30	35	23	25	14			2	73	4981	6
STD	0100	17	83	35	19	25	48	0	419	1	88	4968	9
OBS	0100	17	83	35	19	25	48			1	88	4968	9
STD	0150	14	89	35	00	26	01	0	533	1	46	4941	5
OBS	0150	14	89	35	00	26	01			1	46	4941	5
STD	0200	12	66	34	96	26	45	0	626	1	66	4920	1
OBS	0200	12	66	34	96	26	45			1	66	4920	1
STD	0250	11	62	34	92	26	62	0	704	1	82	4911	2
OBS	0250	11	62	34	92	26	62			1	82	4911	2
STD	0300	10	96	34	89	26	72	0	776	1	93	4906	4
OBS	0300	10	96	34	89	26	72			1	93	4906	4
OBS	0378	10	04	34	85	26	85			1	95	4900	1
STD	0400	09	87	34	84	26	87	0	911	2	08	4899	3
OBS	0473	09	32	34	83	26	95			2	17	4897	0
STD	0500	09	13	34	84	26	99	1	033	1	89	4896	3
OBS	0568	08	64	34	86	27	09			1	45	4894	4
STD	0600	08	37	34	86	27	13	1	145	1	44	4892	9
OBS	0664	07	90	34	87	27	21			1	43	4890	9
OBS	0760	07	33	34	76	27	20			1	50	4888	9
STD	0800	07	10	34	76	27	24	1	347	1	53	4888	4
OBS	0956	06	26	34	77	27	36			1	65	4886	8

Sta. No.

18

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	4°	11	20	18	2	0
II	5°	6	8	8	4	2

Consec. Sta. No. 19						SURFACE OBSERVATIONS					
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0019	04	12	1961	02	04° 03' S	078° 15' E		4663	08	

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
05	32		09	28 9	25 3			01	1 5	32	1			7		27

SUBSURFACE OBSERVATIONS									
	SAMPLE DEPTH (M)	T °C		S‰	σ _t	Σ ΔD	O ₂ m/l	V _t	
		↓	↓						
STD	0000	29 18	35 15	22 14	0 000	4 15	5057 3		
OBS	0000	29 18	35 15	22 14		4 15	5057 3		
OBS	0008	29 18	35 00	22 02		4 20	5057 2		
STD	0010	29 18	35 00	22 02	0 058	4 20	5057 4		
OBS	0017	29 18	35 01	22 03		4 22	5057 8		
STD	0020	29 18	34 98	22 01	0 116	4 27	5057 9		
OBS	0026	29 17	34 94	21 98		4 34	5058 1		
STD	0030	29 00	34 94	22 04	0 174	4 35	5057 1		
OBS	0044	28 35	34 94	22 26		4 42	5053 3		
STD	0050	28 23	35 13	22 44	0 286	4 51	5053 4		
OBS	0065	27 26	35 43	22 98		4 63	5048 3		
STD	0075	25 80	35 41	23 43	0 410	4 60	5037 7		
OBS	0087	24 15	35 38	23 90		4 56	5025 2		
STD	0100	22 35	35 38	24 43	0 511	3 87	5010 9		
OBS	0131	18 94	35 32	25 30		2 58	4981 9		
STD	0150	17 81	35 19	25 48	0 664	2 04	4971 7		
OBS	0176	16 19	35 08	25 78		1 63	4956 7		
STD	0200	14 43	35 07	26 17	0 775	1 72	4939 8		
OBS	0220	13 25	35 05	26 40		1 79	4928 2		
STD	0250	12 00	34 98	26 59	0 861	1 90	4915 8		
OBS	0265	11 57	34 96	26 66		1 95	4911 7		
OBS	0295	11 11	34 97	26 75		2 03	4908 2		
STD	0300	11 05	34 96	26 75	0 933	2 10	4907 8		
OBS	0370	10 32	34 88	26 82		2 61	4903 0		
STD	0400	10 19	34 93	26 88	1 065	2 46	4903 5		
OBS	0446	09 76	34 96	26 98		2 25	4901 2		
STD	0500	08 76	34 88	27 08	1 183	2 06	4891 9		
OBS	0526	08 31	34 85	27 13		1 96	4887 8		
STD	0600	07 13	34 81	27 27	1 282	1 66	4877 1		
OBS	0606	07 06	34 81	27 28		1 64	4876 6		
OBS	0776	06 99	34 79	27 28		1 44	4885 7		

Sta. No.

19

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	17°	11	20	19	2	1
II	36°	6	8	6	4	2

Consec. Sta. No. 20		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0020	04	12	1961	11	02° 57' S		078° 12' E		4864	29

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ▼	WET ▼			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
04	32		76	30 0	26 1		02	1	6	01	2			7	00	26

SUBSURFACE OBSERVATIONS									
	SAMPLE DEPTH (M)	T °C		S% O	σ _t	Σ ΔD	O ₂ m/l	V _t	
		↓	↓					↓	↓
STD	0000	29 45	34 90	21 86	0 000	4 14	5058 3		
OBS	0000	29 45	34 90	21 86		4 14	5058 3		
STD	0010	29 26	34 88	21 91	0 059	4 23	5057 5		
OBS	0010	29 26	34 88	21 91		4 23	5057 5		
OBS	0019	29 16	34 97	22 01		4 22	5057 7		
STD	0020	29 16	34 97	22 01	0 118	4 21	5057 7		
OBS	0029	29 05	35 01	22 08		4 18	5057 6		
STD	0030	29 01	35 04	22 11	0 176	4 20	5057 5		
OBS	0048	28 16	35 39	22 66		4 47	5053 7		
STD	0050	27 98	35 37	22 70	0 285	4 46	5052 5		
OBS	0072	26 43	35 26	23 12		4 30	5041 8		
STD	0075	26 42	35 26	23 12	0 410	3 94	5041 9		
OBS	0096	25 74	35 28	23 35		2 05	5038 0		
STD	0100	25 23	35 28	23 50	0 525	2 07	5034 3		
OBS	0145	19 82	35 25	25 02		2 08	4990 6		
STD	0150	19 12	35 25	25 20	0 707	2 00	4984 4		
OBS	0194	14 52	35 26	26 29		1 61	4941 2		
STD	0200	14 26	35 23	26 33	0 821	1 66	4938 6		
OBS	0243	12 77	35 07	26 51		1 94	4924 3		
STD	0250	12 65	35 07	26 54	0 905	1 97	4923 4		
OBS	0293	11 93	35 07	26 68		2 15	4917 9		
STD	0300	11 80	35 06	26 69	0 980	2 22	4916 8		
OBS	0391	10 43	34 99	26 89		2 71	4906 0		
STD	0400	10 34	34 99	26 90	1 114	2 70	4905 5		
OBS	0488	09 59	34 97	27 02		2 42	4901 7		
STD	0500	09 52	34 98	27 04	1 233	2 29	4901 6		
OBS	0584	09 01	34 99	27 13		1 65	4900 4		
STD	0600	08 90	34 98	27 14	1 343	1 59	4900 0		
OBS	0680	08 36	34 92	27 18		1 42	4897 8		
OBS	0775	07 81				1 47			
STD	0800	07 64	34 88	27 25	1 544	1 48	4895 7		
OBS	0965	06 59	34 84	27 37		1 51	4891 9		
STD	1000	06 39	34 83	27 39	1 725	1 52	4891 3		
OBS	1154	05 55	34 80	27 47		1 64	4889 3		
STD	1200	05 32	34 80	27 50	1 883	1 73	4888 9		
OBS	1439	05 97*	34 79	27 41*		2 16	4911 6		
STD	1500	04 00	34 79	27 64	2 084	2 27	4888 7		
OBS	1915	02 74	34 76	27 74		2 90	4895 6		
STD	2000	02 60	34 76	27 75	2 352	2 98	4898 6		
OBS	2391	02 11	34 75	27 78		3 28	4914 7		
STD	2500	02 01	34 75	27 79	2 577	3 35	4919 7		
OBS	2868	01 80	34 73	27 79		3 54	4938 2		

Sta. No.
20

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	15°	11	20	18	2	1
II	15°	11	17	16	5	3

Consec. Sta. No. 21		SURFACE OBSERVATIONS							
NODC REF. NO.	STATION	DATE				POSITION		SONIC, DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE	LONGITUDE		
00599	0021	04	12	1961	20	02° 00' S	077° 53' E	4846	09

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
05	27		09	30.6	26.7		02	8	2	30	2			7		

SUBSURFACE OBSERVATIONS							
	SAMPLE DEPTH (M)	T °C ↓	S% O ↓	σ _t ↓	Σ ΔD ↓	O ₂ m/l ↓	V _t ↓
STD	0000	29.33	34.95	21.94	0.000	4.22	5057.6
OBS	0000	29.33	34.95	21.94		4.22	5057.6
OBS	0009	29.35	34.96	21.94		4.37	5058.4
STD	0010	29.35	34.96	21.94	0.059	4.35	5058.4
OBS	0018	29.32	34.97	21.96		4.28	5058.7
STD	0020	29.31	34.99	21.97	0.118	4.30	5058.9
OBS	0027	29.24	35.03	22.03		4.34	5058.9
STD	0030	29.16	35.01	22.04	0.176	4.34	5058.5
OBS	0046	28.68	35.00	22.19		4.34	5056.0
STD	0050	28.67	35.06	22.24	0.290	4.36	5056.4
OBS	0069	27.82	35.26	22.67		4.45	5052.1
STD	0075	27.07	35.26	22.91	0.423	4.07	5046.9
OBS	0092	25.02	35.27	23.56		3.21	5032.1
STD	0100	24.10	35.27	23.84	0.537	3.12	5025.2
OBS	0138	19.98	35.26	24.98		2.56	4991.7
STD	0150	18.66	35.19	25.27	0.709	2.17	4979.9
OBS	0184	15.49	35.07	25.94		1.61	4950.0
STD	0200	14.26	35.07	26.20	0.825	1.88	4938.0
OBS	0230	12.56	35.06	26.55		2.15	4921.2
STD	0250	12.05	35.05	26.64	0.908	2.03	4916.6
OBS	0276	11.53	35.04	26.73		1.96	4912.2
STD	0300	11.40	35.02	26.74	0.980	2.12	4912.0
OBS	0350	11.00	35.00	26.79		2.31	4910.3
STD	0400	10.34	34.99	26.90	1.112	2.19	4905.5
OBS	0437	09.93	34.98	26.97		2.14	4902.8
STD	0500	09.43	34.92	27.01	1.232	2.17	4900.2
OBS	0525	09.26	34.91	27.03		2.18	4899.6
STD	0600	08.88	34.90	27.08	1.346	1.86	4899.4
OBS	0616	08.78	34.90	27.09		1.81	4899.1
OBS	0709	08.08	34.88	27.19		1.59	4895.9
STD	0800	07.57	34.89	27.27	1.551	1.40	4894.9
OBS	0907	07.19	34.95	27.37		1.20	4896.6

Sta. No.
21

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	23°	11	20	19	2	1
II	31°	6	8	8	4	3

Consec. Sta. No. 22		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0022	04	13	1961	03	01°	00' S	077°	53' E	4755	08

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR	AMT	DIR	AMT		COL	TRANS
06	32		09	29.4	26.7		02	8	6	32	2			7	00	25

		SUBSURFACE OBSERVATIONS							
		SAMPLE DEPTH (M)	T °C ↓	S‰ O ↓	σ _t ↓	Σ ΔD ↓	O ₂ m/l ↓	V _t ↓	
STD	0000	29	32	34 65	21 72	0 000	4 25	5056 5	
OBS	0000	29	32	34 65	21 72		4 25	5056 5	
OBS	0009	29	31	34 60	21 68		4 35	5056 9	
STD	0010	29	31	34 60	21 68	0 061	4 36	5056	
OBS	0018	29	29	34 60	21 69		4 39	5057 3	
STD	0020	29	29	34 60	21 69	0 123	4 37	5057 4	
OBS	0027	29	29	34 61	21 70		4 33	5057 8	
STD	0030	29	27	34 65	21 73	0 184	4 35	5058 0	
OBS	0044	29	15	34 82	21 90		4 41	5058 6	
STD	0050	29	04	34 91	22 00	0 303	4 41	5058 5	
OBS	0066	27	81	35 11	22 56		4 42	5051 3	
STD	0075	26	02	35 18	23 18	0 435	3 83	5038 6	
OBS	0088	23	89	35 26	23 89		3 21	5022 7	
STD	0100	23	17	35 32	24 15	0 542	3 17	5017 6	
OBS	0131	20	75	35 38	24 87		3 07	4998 7	
STD	0150	18	46	35 32	25 42	0 703	2 63	4978 4	
OBS	0174	16	01	35 24	25 95		2 26	4955 4	
STD	0200	13	79	35 15	26 37	0 812	2 17	4933 3	
OBS	0219	12	72	35 11	26 55		2 11	4922 5	
STD	0250	12	27	35 11	26 64	0 892	1 99	4919 3	
OBS	0265	12	09	35 10	26 67		1 96	4918 1	
STD	0300	11	89	35 07	26 68	0 964	2 01	4917 8	
OBS	0326	11	67	35 05	26 71		2 03	4916 8	
STD	0400	10	62	35 02	26 88	1 100	1 94	4908 9	
OBS	0410	10	50	35 02	26 90		1 93	4908 1	
OBS	0493	09	77	34 97	26 99		2 04	4904 1	
STD	0500	09	70	34 97	27 00	1 223	2 01	4903 7	
OBS	0579	09	02	34 94	27 09		1 78	4900 0	
STD	0600	08	89	34 95	27 12	1 335	1 75	4899 7	
OBS	0665	08	47	34 97	27 20		1 65	4898 5	
STD	0800	07	61	34 99	27 34	1 530	1 38	4895 8	
OBS	0848	07	31	34 99	27 39		1 26	4894 8	

Sta. No.
22

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	25°	11	20	19	2	1
II	39°	6	8	7	4	2

Consec. Sta. No. 23		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0023	04	13	1961	18	00	00' N	078	00' E	4663	24

WIND		ANEMO. HGT	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
05	27		10	28.3	26.7		02	8	2	27	2			7	00	

	SAMPLE DEPTH (M)	SUBSURFACE OBSERVATIONS											
		T °C		S ‰	σ _t ↓	Σ ΔD ↓	O ₂ ml/l ↓	V _t ↓					
		↓	↓										
STD	0000	29	13	34	69	21	81	0	000	4	06	5055	3
OBS	0000	29	13	34	69	21	81			4	06	5055	3
OBS	0009	29	14	34	67	21	79			4	22	5055	9
STD	0010	29	14	34	68	21	80	0	060	4	22	5056	0
OBS	0018	29	11	34	73	21	85			4	23	5056	4
STD	0020	29	10	34	73	21	85	0	120	4	25	5056	5
OBS	0027	28	96	34	72	21	89			4	28	5055	9
STD	0030	28	77	34	74	21	97	0	180	4	27	5054	8
OBS	0045	27	81	34	92	22	42			4	15	5049	4
STD	0050	27	61	35	07	22	60	0	291	4	09	5048	7
OBS	0068	26	24	35	40	23	28			3	72	5040	6
STD	0075	25	21	35	39	23	59	0	411	3	45	5033	0
OBS	0091	23	01	35	36	24	22			2	87	5015	9
STD	0100	21	99	35	31	24	48	0	509	2	46	5007	5
OBS	0137	18	00	35	19	25	44			1	45	4972	8
STD	0150	16	34	35	19	25	83	0	652	1	52	4957	1
OBS	0183	13	44	35	18	26	46			1	68	4928	6
STD	0200	13	09	35	15	26	51	0	748	1	75	4925	6
OBS	0230	12	54	35	11	26	59			1	82	4921	2
STD	0250	12	17	35	10	26	65	0	824	1	80	4918	2
OBS	0277	11	89	35	09	26	70			1	77	4916	5
STD	0300	11	88	35	08	26	69	0	896	1	74	4917	8
OBS	0304	11	88	35	08	26	69			1	73	4918	0
OBS	0380	11	71	35	06	26	71			1	84	4920	5
STD	0400	11	26	35	03	26	77	1	037	1	91	4916	4
OBS	0456	10	28	34	99	26	92			1	92	4908	1
STD	0500	09	84	35	00	27	00	1	165	1	63	4905	5
OBS	0530	09	60	35	01	27	05			1	49	4904	4
STD	0600	09	27	35	05	27	13	1	277	1	36	4904	7
OBS	0605	09	24	35	05	27	14			1	35	4904	7
OBS	0757	08	39	35	01	27	24			1	07	4903	1
STD	0800	07	95	35	00	27	30	1	475	1	03	4900	1
OBS	0909	07	14	34	97	27	40			1	00	4896	2
STD	1000	07	10	34	94	27	38	1	654	1	14	4900	9
OBS	1138	06	78	34	91	27	40			1	35	4904	9
STD	1200	06	26	34	90	27	46	1	821	1	47	4901	8
STD	1500	04	26	34	85	27	66	2	030	1	99	4892	6
OBS	1531	04	10	34	85	27	68			2	03	4892	2
OBS	1934	02	87	34	82	27	78			2	48	4898	8
STD	2000	02	72	34	81	27	78	2	290	2	57	4900	5
OBS	2354	02	20	34	77	27	79			3	09	4913	8

Sta. No.
23

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	15°	11	20	17	2	1
II	40°	11	17	15	5	2

Consec. Sta. No. 24		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0024	04	14	1961	06	00° 56' N	078° 01' E	4663	10		

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR	AMT	DIR	AMT		COL.	TRANS
08	32		10	28	9	26	1		03	8	32	2		7	00	24

		SUBSURFACE OBSERVATIONS											
		SAMPLE DEPTH (M)	T °C		S‰		σ _t	Σ ΔD	O ₂ ml/l	V _t			
			↓		↓						↓		
STD	0000	29	42	34	65	21	68	0	000	4	14	5057	2
	OBS	0000	29	42	34	65	21	68		4	14	5057	2
STD	0010	29	41	34	64	21	68	0	061	4	21	5057	8
	OBS	0010	29	41	34	64	21	68		4	21	5057	8
STD	0020	29	31	34	65	21	72	0	123	4	14	5057	7
	OBS	0020	29	31	34	65	21	72		4	14	5057	7
STD	0030	29	23	34	64	21	74	0	184	4	28	5057	7
	OBS	0030	29	23	34	64	21	74		4	28	5057	7
STD	0050	28	16	34	92	22	30	0	300	4	30	5052	2
	OBS	0050	28	16	34	92	22	30		4	30	5052	2
STD	0075	25	99	35	04	23	09	0	430	3	58	5037	9
	OBS	0075	25	99	35	04	23	09		3	58	5037	9
STD	0100	23	06	35	25	24	13	0	538	2	52	5016	5
	OBS	0100	23	06	35	25	24	13		2	52	5016	5
STD	0150	18	63	35	15	25	25	0	704	1	38	4979	4
	OBS	0150	18	63	35	15	25	25		1	38	4979	4
STD	0200	13	52	35	13	26	41	0	815	1	58	4930	3
	OBS	0200	13	52	35	13	26	41		1	58	4930	3
STD	0250	12	35	35	10	26	62	0	895	1	64	4920	2
	OBS	0250	12	35	35	10	26	62		1	64	4920	2
STD	0300	11	96	35	08	26	68	0	968	1	76	4918	7
	OBS	0300	11	96	35	08	26	68		1	76	4918	7
OBS	0398	11	06	35	06	26	83			1	64	4914	1
	STD	0400	11	04	35	06	26	83	1	107	1	64	4913
OBS	0497	11	25	35	01	26	76	*		1	59	4921	9
	STD	0500	10	23	35	01	26	94	1	234	1	58	4910
OBS	0597	09	53	35	02	27	07			1	34	4907	6
	STD	0600	09	51	35	02	27	07	1	352	1	33	4907
OBS	0697	08	90	35	03	27	18			1	15	4905	9
	OBS	0797	08	07	35	02	27	30		1	06	4901	5
STD	0800	08	05	35	02	27	30	1	557	1	06	4901	4
	OBS	0996	06	67	34	98	27	47		1	20	4895	3

Sta. No.
24

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	5°	11	20	20	2	1
II	3°	6	8	7	4	3

Consec. Sta. No. 25		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0025	04	14	1961	18	02 ° 00' N		077 ° 57' E		4297	10

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
04	26		10	29 8	25 6			02	8	3	26	2		7	00	

SUBSURFACE OBSERVATIONS									
SAMPLE DEPTH (M)		T °C ↓	S‰ O ↓	σ _t ↓	Σ ΔD ↓	O ₂ m/l ↓	V _t ↓		
STD	0000	29 63				4 03			
OBS	0000	29 63	35 08*	21 93*		4 03	5060	2*	
STD	0010	29 63	34 89	21 79		4 15	5060	1	
OBS	0010	29 63	34 89	21 79		4 15	5060	1	
STD	0020	29 52	34 92	21 85		4 20	5060	1	
OBS	0020	29 52	34 92	21 85		4 20	5060	1	
STD	0030	28 57	34 79	22 07		4 25	5053	5	
OBS	0030	28 57	34 79	22 07		4 25	5053	5	
STD	0050	28 22	34 88	22 25		4 25	5052	5	
OBS	0050	28 22	34 88	22 25		4 25	5052	5	
STD	0075	26 76	34 92	22 76		3 76	5043	3	
OBS	0075	26 76	34 92	22 76		3 76	5043	3	
STD	0100	23 21	34 96	23 86		2 38	5016	7	
OBS	0100	23 21	34 96	23 86		2 38	5016	7	
STD	0150	17 10	34 98	25 49		0 68	4963	9	
OBS	0150	17 10	34 98	25 49		0 68	4963	9	
STD	0200	13 41	35 08	26 39		1 19	4928	9	
OBS	0200	13 41	35 08	26 39		1 19	4928	9	
STD	0250	12 24	35 00	26 56		1 79	4918	5	
OBS	0250	12 24	35 00	26 56		1 79	4918	5	
STD	0300	11 36	35 04	26 76		1 92	4911	6	
OBS	0300	11 36	35 04	26 76		1 92	4911	6	
OBS	0398	11 11	35 02	26 79		1 93	4914	5	
STD	0400	11 09	35 02	26 79		1 90	4914	4	
OBS	0496	10 38	35 05	26 94		0 96	4911	9	
STD	0500	10 37	35 05	26 95		0 97	4912	0	
OBS	0596	09 79	35 02	27 02		1 05	4910	7	
STD	0600	09 74	35 02	27 03		1 03	4910	3	
OBS	0695	08 69	35 02	27 20		0 78	4903	2	
OBS	0794	07 87	34 99	27 31		0 95	4898	7	
STD	0800	07 83	34 99	27 31		0 96	4898	6	
OBS	0993	06 67	34 93	27 43		1 08	4895	0	

Sta. No.

25

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	0°	11	20	19	2	1
II	2°	6	8	8	4	2

Consec. Sta. No. 26		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0026	04	15	1961	02	03°	00' N	077°	53' E	3292	29

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY	WET			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
04	32		09	30	0	26	1	01	9	8	32	2		7	00	23

		SUBSURFACE OBSERVATIONS											
		SAMPLE DEPTH (M)	T °C		S‰	σ _t		Σ ΔD	O ₂ ml/l	V _t			
			↓	↓		↓	↓						
STD	0000	29	50	34	92	21	86	0 000	4	15	5058	7	
OBS	0000	29	50	34	92	21	86		4	15	5058	7	
STD	0010	29	48	34	91	21	86	0 060	4	26	5059	2	
OBS	0010	29	48	34	91	21	86		4	26	5059	2	
STD	0020	29	48	34	91	21	86	0 119	4	21	5059	8	
OBS	0020	29	48	34	91	21	86		4	21	5059	8	
STD	0030	29	41	34	93	21	89	0 179	4	30	5060	0	
OBS	0030	29	41	34	93	21	89		4	30	5060	0	
STD	0050	28	49	35	03	22	28	0 294	4	38	5055	0	
OBS	0050	28	49	35	03	22	28		4	38	5055	0	
STD	0075	26	50	35	22	23	06	0 425	4	16	5042	4	
OBS	0075	26	50	35	22	23	06		4	16	5042	4	
STD	0100	25	64	35	27	23	37	0 542	3	32	5037	5	
OBS	0100	25	64	35	27	23	37		3	32	5037	5	
STD	0150	15	21	35	02	25	96	0 709	0	83	4944	9	
OBS	0150	15	21	35	02	25	96		0	83	4944	9	
STD	0200	13	41	35	06	26	37	0 804	0	80	4928	8	
OBS	0200	13	41	35	06	26	37		0	80	4928	8	
STD	0250	12	76	35	10	26	54	0 886	1	44	4924	8	
OBS	0250	12	76	35	10	26	54		1	44	4924	8	
STD	0300	11	67	35	09	26	74	0 960	1	34	4915	4	
OBS	0300	11	67	35	09	26	74		1	34	4915	4	
OBS	0391	11	02	35	07	26	85		1	34	4913	2	
STD	0400	10	97	35	07	26	85	1 095	1	29	4913	2	
OBS	0488	10	43	35	09	26	97		0	96	4912	1	
STD	0500	10	35	35	09	26	98	1 219	0	96	4911	9	
OBS	0586	09	67	35	06	27	07		0	89	4908	8	
STD	0600	09	50	35	06	27	10	1 334	0	84	4907	6	
OBS	0684	08	67	35	03	27	21		0	67	4902	3	
OBS	0782	08	19	35	00	27	27		0	75	4902	0	
STD	0800	08	06	34	99	27	28	1 538	0	78	4901	5	
OBS	0978	06	85	34	94	27	41		1	12	4896	4	
STD	1000	06	71	34	94	27	43	1 714	1	17	4895	9	
OBS	1173	05	69	34	91	27	54		1	49	4892	7	
STD	1200	05	57	34	90	27	55	1 865	1	52	4892	7	
OBS	1467	04	43	34	86	27	65		1	88	4893	0	
STD	1500	04	29	34	85	27	66	2 059	1	93	4893	0	
OBS	1956	02	82	34	80	27	76		2	63	4899	3	
STD	2000	02	74	34	80	27	77	2 323	2	74	4900	8	
OBS	2446	02	08	34	78	27	81		3	38	4917	6	
STD	2500	02	02	34	78	27	82	2 541	3	34	4919	9	
OBS	2936	01	76	34	75	27	81		3	00	4941	8	

Sta. No.
26

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	2°	11	20	18	2	1
II	5°	11	17	14	5	3

Consec. Sta. No. 27		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0027	04	15	1961	14	03° 50' N		078° 01' E		3127	28

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR	AMT.		COL.	TRANS.
05	29		08	30	6	26	1	02	8	2	30	2		7	00	

		SUBSURFACE OBSERVATIONS											
		SAMPLE DEPTH (M)	T °C		S % O		σ _t		Σ ΔD	O ₂ m/l	V _t		
			↓		↓		↓		↓			↓	
STD	0000	29	68	34	47	21	46	0	000	4	06	5058	4
OBS	0000	29	68	34	47	21	46			4	06	5058	4
OBS	0009	29	66	34	47	21	47			4	15	5058	9
STD	0010	29	65	34	54	21	52	0	063	4	16	5059	
OBS	0018	29	54	34	91	21	84			4	23	5060	1
STD	0020	29	48	34	91	21	86	0	125	4	23	5059	8
OBS	0027	29	32	34	91	21	91			4	23	5059	1
STD	0030	29	31	34	91	21	91	0	184	4	23	5059	2
OBS	0045	29	22	34	92	21	95			4	23	5059	5
STD	0050	29	14	34	93	21	99	0	302	4	24	5059	3
OBS	0068	28	86	34	97	22	11			4	26	5058	5
STD	0075	28	42	35	05	22	32	0	445	4	19	5056	1
OBS	0091	26	97	35	18	22	88			3	83	5046	8
STD	0100	25	30	35	15	23	38	0	571	3	13	5034	4
OBS	0136	19	67	35	08	24	93			1	25	4988	1
STD	0150	17	92	35	08	25	37	0	751	1	06	4972	4
OBS	0181	15	01	35	09	26	06			0	91	4944	9
STD	0200	14	15	35	11	26	26	0	864	1	10	4937	0
OBS	0226	13	18	35	13	26	48			1	33	4928	1
STD	0250	12	56	35	13	26	60	0	947	1	52	4922	6
OBS	0271	12	10	35	12	26	68			1	61	4918	7
STD	0300	11	87	35	10	26	71	1	020	1	48	4917	7
OBS	0372	11	06	35	08	26	85			1	18	4912	6
STD	0400	10	50	35	08	26	95	1	152	1	06	4907	7
OBS	0465	09	53	35	08	27	11			0	86	4900	0
STD	0500	09	46	35	08	27	13	1	265	0	85	4901	2
OBS	0558	09	74	35	07	27	07*			0	80	4908	0
STD	0600	09	41	35	07	27	13	1	371	0	71	4906	5
OBS	0651	09	17	35	06	27	16			0	63	4906	6
OBS	0745	08	43	35	04	27	26			0	58	4903	0
STD	0800	07	97	35	03	27	32	1	569	0	67	4900	5
OBS	0934	06	97	34	99	27	44			0	89	4895	6
STD	1000	06	57	34	97	27	47	1	736	1	01	4894	2
OBS	1122	05	86	34	94	27	54			1	22	4892	1
STD	1200	05	40	34	92	27	59	1	879	1	36	4890	5
OBS	1406	04	35	34	88	27	68			1	72	4888	4
STD	1500	04	01	34	87	27	70	2	059	1	90	4889	2
OBS	1880	02	94	34	82	27	77			2	45	4896	6
STD	2000	02	76	34	81	27	78	2	309	2	54	4901	1
OBS	2358	02	29	34	79	27	80			2	80	4915	5
STD	2500	02	12	34	78	27	81	2	529	2	91	4921	4
OBS	2836	01	77	34	77	27	83			3	17	4936	1

Sta. No.
27

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	20°	11	20	19	2	1
II	32°	11	17	16	5	2

Consec. Sta. No. 28		SURFACE OBSERVATIONS									
NODC REF. NO	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0028	04	22	1961	02	08 ° 00' N		069 ° 46' E		4572	28

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR	AMT.		COL.	TRANS.
05	28		09	29	4	25	2		02	8	4	28	2		7	00 28

		SUBSURFACE OBSERVATIONS										
		DEPTH (M)	T °C	S ‰		σ _t		Σ ΔD	O ₂ m/l	V _t		
STD	0000	29	71	35	04	21	88	0 000	4	17	5060	6
OBS	0000	29	71	35	04	21	88		4	17	5060	6
STD	0010	29	72	35	04	21	87	0 060	4	31	5061	3
OBS	0010	29	72	35	04	21	87		4	31	5061	3
OBS	0019	29	78	35	13	21	92		4	22	5062	5
STD	0020	29	74	35	17	21	96	0 119	4	26	5062	5
OBS	0029	29	36	35	46	22	31		4	50	5061	3
STD	0030	29	33	35	50	22	35	0 176	4	52	5061	3
OBS	0049	28	57	35	87	22	88		4	56	5058	4
STD	0050	28	57	35	82	22	84	0 281	4	53	5058	3
OBS	0074	26	78	35	10	22	88		3	82	5044	1
STD	0075	26	50	35	11	22	98	0 406	3	68	5042	0
OBS	0098	21	37	35	31	24	65		1	15	5002	0
STD	0100	21	26	35	30	24	67	0 509	1	14	5001	1
OBS	0148	18	28	35	09	25	29		0	80	4975	7
STD	0150	18	10	35	09	25	33	0 659	0	78	4974	1
OBS	0197	14	73	35	06	26	10		0	41	4942	8
STD	0200	14	61	35	07	26	13	0 775	0	41	4941	7
OBS	0246	13	20	35	21	26	53		0	38	4929	8
STD	0250	13	16	35	21	26	54	0 863	0	39	4929	6
OBS	0296	12	75	35	19	26	61		0	43	4927	7
STD	0300	12	74	35	19	26	61	0 940	0	43	4927	8
OBS	0363	12	19	35	21	26	73		0	45	4925	5
STD	0400	11	03	35	18	25	93	1 078	0	59	4914	3
OBS	0453	09	99	35	15	27	09		0	68	4905	1
STD	0500	09	93	35	15	27	10	1 193	0	60	4907	2
OBS	0544	09	88	35	14	27	10		0	55	4909	1
STD	0600	09	48	35	12	27	15	1 300	0	54	4907	6
OBS	0635	09	25	35	11	27	18		0	53	4906	8
OBS	0725	08	71	35	10	27	26		0	55	4905	5
STD	0800	08	36	35	06	27	29	1 499	0	68	4905	5
OBS	0912	07	71	35	01	27	35		0	85	4903	8
STD	1000	06	93	34	99	27	44	1 674	0	95	4899	0
OBS	1104	06	26	34	96	27	51		1	07	4896	3
STD	1200	06	23	34	94	27	50	1 831	1	19	4901	5
OBS	1388	05	87	34	91	27	52		1	46	4907	8
STD	1500	05	03	34	87	27	59	2 048	1	73	4903	1
OBS	1870	03	04	34	79	27	74		2	45	4897	3
STD	2000	02	80	34	79	27	76	2 338	2	61	4901	6
OBS	2350	02	29	34	78	27	79		2	94	4914	9
STD	2500	02	12	34	77	27	80	2 564	3	04	4921	3
OBS	2832	01	87	34	73	27	79		3	19	4937	1

Sta. No.

28

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	13°	11	20	20	2	0
II	25°	11	17	17	5	2

Consec. Sta. No. 29		SURFACE OBSERVATIONS									
NODC REF. + NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00599	0029	04	23	1961	12	08° 00' N		057° 08' E		4023	29

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR.	AMT.		COL.	TRANS.
02	27		08	30	7	25	0	03	8	2	00	0		7	00	25

SUBSURFACE OBSERVATIONS									
	SAMPLE DEPTH (M)	T °C		S‰	σ _t	Σ ΔD	O ₂ m/l	V _T	↓
		↓	↓						
STD	0000	29	57	35	00	21 89	0 000	4 12	5059 5
OBS	0000	29	57	35	00	21 89		4 12	5059 5
STD	0010	29	56	34	99	21 89	0 059	4 25	5060 0
OBS	0010	29	56	34	99	21 89		4 25	5060 0
OBS	0019	29	49	35	01	21 93		4 26	5060 1
STD	0020	29	49	35	02	21 94	0 119	4 26	5060 2
OBS	0028	29	45	35	14	22 04		4 29	5060 8
STD	0030	29	33	35	17	22 10	0 177	4 32	5060 2
OBS	0047	28	42	35	38	22 56		4 45	5055 5
STD	0050	28	39	35	42	22 60	0 287	4 44	5055 6
OBS	0072	27	42	35	66	23 10		4 35	5050 7
STD	0075	27	10	35	68	23 22	0 412	4 13	5048 5
OBS	0095	25	06	35	74	23 90		2 86	5034 2
STD	0100	24	67	35	72	24 01	0 520	2 62	5031 4
OBS	0143	20	90	35	55	24 96		1 28	5001 4
STD	0150	19	94	35	50	25 18	0 690	1 30	4992 9
OBS	0191	15	87	35	29	26 02		1 41	4955 2
STD	0200	15	62	35	28	26 07	0 812	1 45	4953 1
OBS	0238	14	45	35	25	26 30		1 55	4943 0
STD	0250	13	94	35	24	26 40	0 904	1 54	4938 2
OBS	0286	12	71	35	23	26 65		1 49	4926 8
STD	0300	12	51	35	23	26 69	0 983	1 46	4925 4
OBS	0385	11	52	35	23	26 88		1 23	4919 3
STD	0400	11	41	35	24	26 91	1 118	1 18	4918 9
OBS	0480	10	92	35	28	27 03		0 91	4918 2
STD	0500	10	84	35	28	27 04	1 238	0 82	4918 4
OBS	0575	10	50	35	27	27 09		0 62	4918 8
STD	0600	10	37	35	28	27 13	1 349	0 65	4918 8
OBS	0670	10	00	35	29	27 20		0 68	4918 6
OBS	0766	09	50	35	29	27 28		0 63	4918 3
STD	0800	09	22	35	27	27 31	1 551	0 65	4916 9
OBS	0957	07	98	35	19	27 45		0 75	4910 6
STD	1000	07	66	35	17	27 48	1 723	0 78	4909 0
OBS	1148	06	64	35	10	27 57		0 94	4904 5
STD	1200	06	32	35	07	27 59	1 870	1 03	4903 3
OBS	1436	06	77*	34	96	27 44*		1 46	4922 6
STD	1500	04	69	34	94	27 68	2 061	1 63	4898 8
OBS	1916	03	12	34	83	27 76		2 47	4901 3
STD	2000	02	94	34	83	27 78	2 323	2 53	4903 7
OBS	2402	02	29	34	82	27 83		2 81	4918 2
STD	2500	02	18	34	81	27 83	2 541	2 87	4922 4
OBS	2892	01	92	34	77	27 82		3 11	4941 6

Sta. No.
29

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	12°	11	20	17	2	0
II	19°	11	17	17	5	2

Consec. Sta. No. 30		SURFACE OBSERVATIONS									
NODC REF. NO.	STATION	DATE				POSITION				SONIC DEPTH UNCORRECTED	MAX. SAMPLE DEPTH
		MO.	DAY	YEAR	HOUR	LATITUDE		LONGITUDE			
00595	0030	04	25	1961	09	12 °	00' N	054 °	00' E	0750	07

WIND		ANEMO. HGT.	AIR PRESS	AIR TEMPERATURE		HUMID- ITY	WEATHER	CLOUD		SEA		SWELL		VIS.	WATER	
SPEED	DIR.			DRY ↓	WET ↓			TYPE	AMT.	DIR.	AMT.	DIR	AMT.		COL.	TRANS.
00	00		12	30 0	24 4		01	1	2	00	0			7	00	27

		SUBSURFACE OBSERVATIONS								
		SAMPLE DEPTH (M)	T °C ↓	S‰ O ↓	σ _t ↓	Σ ΔD ↓	O ₂ ml/l ↓	V _t ↓		
STD	0000	29	57	36 24	22 82	0 000	3 70	5063 7		
ORS	0000	29	57	36 24	22 82		3 70	5063 7		
STD	0010	28	96	36 29	23 07	0 049	4 16	5060 2		
ORS	0010	28	96	36 29	23 07		4 16	5060 2		
STD	0020	28	72	36 28	23 14	0 097	4 14	5059 1		
ORS	0020	28	72	36 28	23 14		4 14	5059 1		
STD	0030	28	26	36 33	23 33	0 144	4 28	5056 6		
ORS	0030	28	26	36 33	23 33		4 28	5056 6		
STD	0050	27	82	36 29	23 44	0 234	4 30	5054 4		
ORS	0050	27	05*	36 29	23 69*		4 30	5048 8		
STD	0075	27	27	36 13	23 50	0 345	3 38	5051 4		
ORS	0075	27	27	36 13	23 50		3 38	5051 4		
STD	0100	24	20	35 99	24 35	0 446	2 93	5028 5		
ORS	0100	24	20	35 99	24 35		2 93	5028 5		
STD	0150	19	15	35 59	25 45	0 601	1 07	4986 0		
ORS	0150	19	15	35 59	25 45		1 07	4986 0		
STD	0200	16	57	35 56	26 06	0 717	0 52	4963 8		
ORS	0200	16	57	35 56	26 06		0 52	4963 8		
STD	0250	15	03	35 57	26 42	0 809	0 45	4951 0		
ORS	0250	15	03	35 57	26 42		0 45	4951 0		
STD	0300	14	53	35 60	26 55	0 891	0 42	4948 8		
ORS	0300	14	53	35 60	26 55		0 42	4948 8		
ORS	0399	13	13	35 57	26 83		0 36	4939 5		
STD	0400	13	12	35 57	26 83	1 037	0 36	4939 4		
ORS	0498	12	09	35 58	27 04		0 35	4933 8		
STD	0500	12	08	35 58	27 04	1 162	0 35	4933 8		
ORS	0598	11	47	35 57	27 15		0 36	4932 6		
STD	0600	11	46	35 57	27 15	1 273	0 36	4932 6		
ORS	0698	10	89	35 55	27 24		0 35	4931 8		
ORS	0736	10	63	35 54	27 28		0 43	4931 0		

Sta. No.
30

Cast No.	Wire Angle	Nansen Bottles	THERMOMETERS			
			Protected		Unprotected	
			Used	Accepted	Used	Accepted
I	2°	11	20	19	2	1
II	5°	5	7	6	3	0

U. S. Naval Oceanographic Office
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(WAGB-279) IN 1961, October 1963.
84 p., including 25 figs., 1 table, (TR-141).

Contains results of 30 oceanographic stations taken in the Indian Ocean by USCGC EASTWIND during a return voyage from Antarctica in 1961. Starting West of Australia, stations were taken along the 32°S parallel, the 78°E meridian, and from 8°N 70°E to 12°N 54°E. Red Sea surface temperatures and salinities are included. Oceanography of Indian Ocean is discussed. Vertical distribution profiles of temperature, salinity, density (sigma-t), dissolved oxygen, percentage saturation of dissolved oxygen, and sound velocity; selected vertical distribution graphs; and temperature salinity curves are presented. Transparency and depth of deep scattering layer were measured. Appendix A contains a tabulation of oceanographic data for the 30 stations.

1. Indian Ocean - Oceanography
2. Oceanography - Indian Ocean
3. Ships - USCGC EASTWIND
- i. Title: Oceanographic Stations Taken in the Indian Ocean by USCGC EASTWIND (WAGB-279) in 1961.

ii. Author: Willis L. Tressler

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